May, 1932

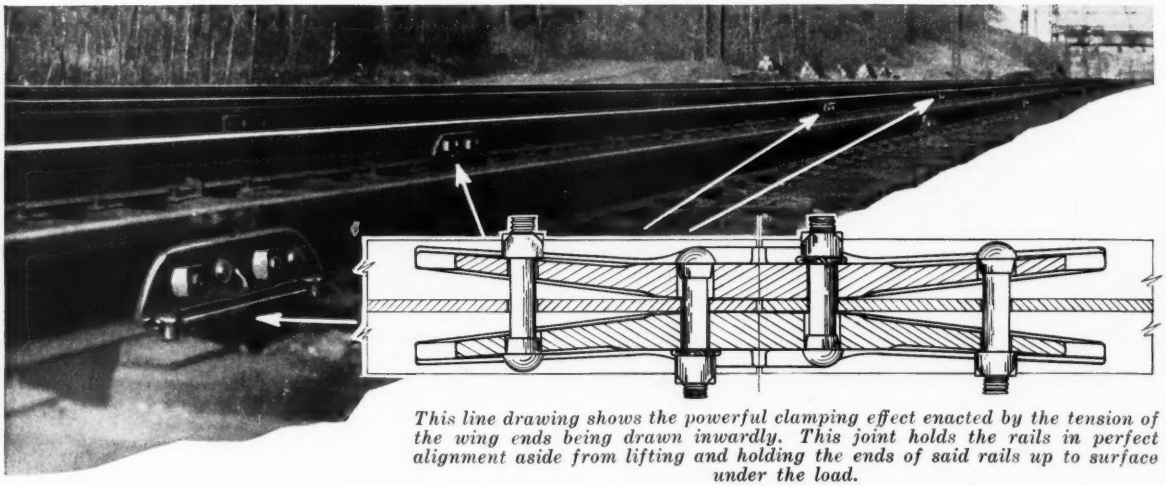
Railway Engineering and Maintenance

HEADFREE RAIL JOINTS

LENGTHEN LIFE OF RAILS

THE RAIL JOINT COMPANY
165 BROADWAY NEW YORK

OF THE 69 RAILROADS—STANDARD ON 6



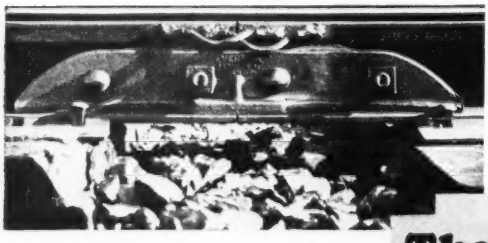
This line drawing shows the powerful clamping effect enacted by the tension of the wing ends being drawn inwardly. This joint holds the rails in perfect alignment aside from lifting and holding the ends of said rails up to surface under the load.

A Revolutionary Accomplishment in Rail Joint Function

EVERTITE Rail Joints very materially add to the life of worn rail—"*cold rolling out batter*"—smoothing out end surface scored by years of impact.

Specified for the Difficult Tasks

This unique design of rail joint is rapidly gaining recognition based entirely on it's merit. Service-proved as an outstanding element of rail coupling. The **EVERTITE** joint secures maximum holding power accomplishing—*Low Maintenance—Smooth Riding Track*—the ultimate results of which, spell economy—the order of the day.



STANDARD EQUIPMENTS INC.
415 Lexington Avenue NEW YORK

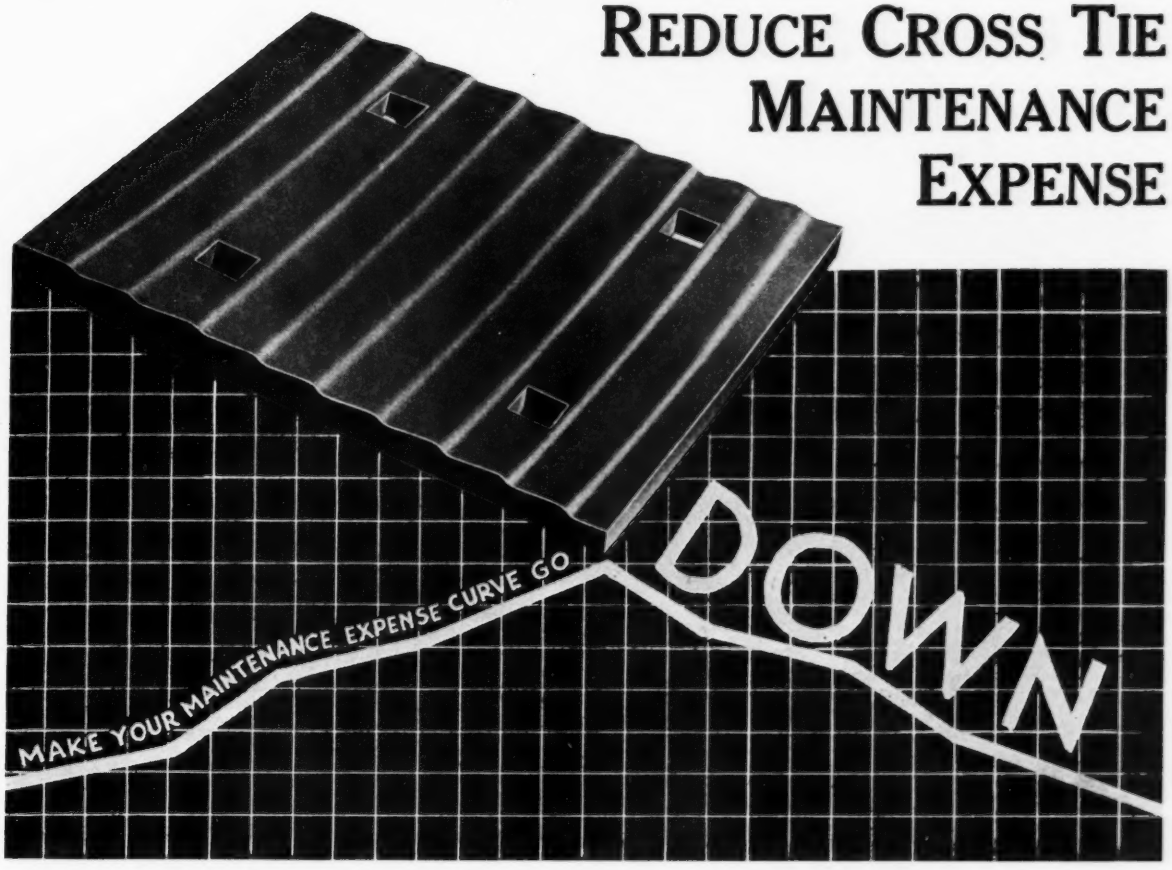
Complete Details
And Performance Records
On Request

The **EVERTITE Rail Joint**

RAILWAY ENGINEERING AND MAINTENANCE
Published monthly by Simmons-Boardman Publishing Co., at 2200 Port Washington Road, Milwaukee, Wisconsin. Entered as second class matter February 14, 1931, at the postoffice at Milwaukee, Wisconsin, under the Act of March 3, 1879.

Alphabetical Index to Advertisers, Page 362

REDUCE CROSS TIE MAINTENANCE EXPENSE



Insure Maximum Tie Life and Minimum Tie Renewals

RAILROADS using Lundie Tie Plates are now reaping big benefits in the form of reduced tie renewals. These roads have a decided advantage during the present economic crisis—because they have reduced their annual tie renewals year after year to a point where they are now realizing worth-while savings in cross-tie maintenance expense.

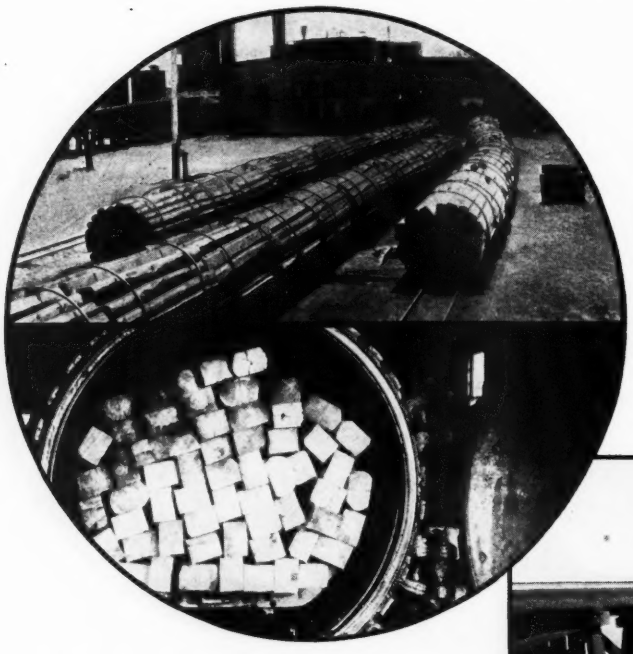
The savings accruing from Lundie Tie Plates are cumulative. They get bigger and bigger each year as more Lundie Plates are placed in track and consequently tie-renewals become fewer and fewer. The tie-renewal curve and the tie-maintenance expense curve are definitely downward.

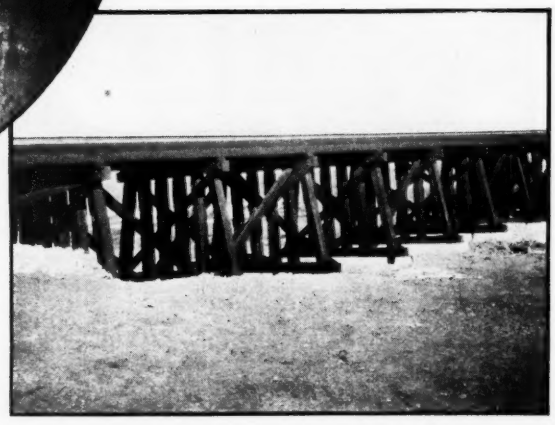
The Lundie Tie Plate gives superior service because it is more than just a tie plate—it is a tie protector. The complete elimination of sharp tie destroying projections protects ties against mechanical wear and assures 100 per cent service-life from treated ties. Millions in service prove this.

Low first cost and assured returns make this an economic device of the highest order.

The Lundie Engineering Corporation
285 Madison Avenue, New York
59 East Van Buren Street, Chicago

LUNDIE TIE PLATE





Reduce Maintenance Costs

One of the most important achievements of today in railroading is to reduce the maintenance cost and increase the life of materials used in equipment.

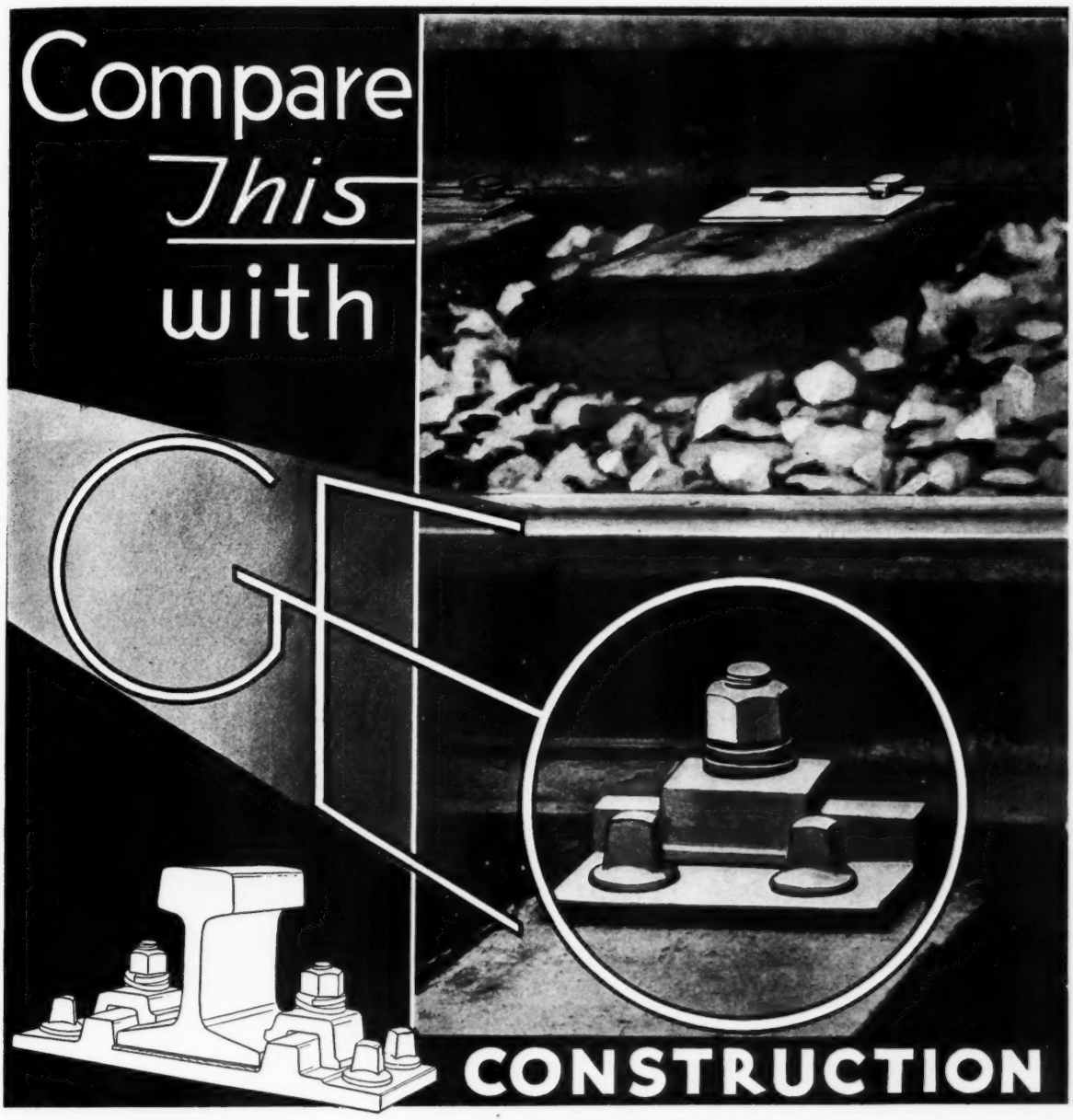
Wood Preserving Oil is one of the important factors in accomplishing this, not only for preserving ties, bridge timbers, and piles, but also in cars and buildings. Wood Preserving Liquid Asphaltum manufactured by the Standard Oil Co. (Indiana) is the Preservative getting results.

Dust-laying, weed-killing, and rail protective coating as manufactured and furnished by the Standard Oil Co. (Indiana) also materially helps reduce maintenance up-keep. Up-to-date railroad administration has proved this beyond a question of doubt.

STANDARD OIL COMPANY
(INDIANA)
910 SOUTH MICHIGAN AVENUE CHICAGO, ILLINOIS 105-B

Billings	Decatur	Detroit	Fargo	Huron	Kansas City	Mason City	Minot	Saginaw	St. Louis
Cheyenne	Denver	Duluth	Grand Rapids	Indianapolis	La Crosse	Minneapolis	Peoria	Sioux City	St. Joseph
Davenport	Des Moines	Evansville	Green Bay	Joliet	Mankato	Milwaukee	Quincy	South Bend	Wichita

ASPHALTS FOR EVERY PURPOSE



CEO Track Construction is not new and untried. Service reports conclusively prove its merit, and a trial installation will convince you. If you do not have a copy, ask for the new **CEO** *Bulletin No. 2*

CARNEGIE STEEL COMPANY · PITTSBURGH

Subsidiary of United States Steel Corporation 181

USS

AN INDEPENDENT UNIT

PREPARING a grade for a switch track—not a big job, but a necessary one. See how simply it is handled! The "Caterpillar" Tractor and Grader, the tractor driver, the grader operator—that's the entire equipment and crew. No cumbersome machinery—no track-tied units.

Yesterday this same tractor was spreading cinders in a muddy yard. Tomorrow it may be doing any of a score of other tasks, for the uses of the versatile "Caterpillar" Tractor are almost endless—in the yards, in the shops, or on the right-of-way.

Caterpillar Tractor Co., Peoria, Illinois, U. S. A.

Track-type Tractors Combines Road Machinery

(There's a "Caterpillar" Dealer Near You)

• • •

Prices—f. o. b. Peoria, Illinois

FIFTEEN	$1100	THIRTY-FIVE	$2400
TWENTY	$1450	FIFTY	$3675
TWENTY-FIVE	$1900	SIXTY-FIVE	$4350
DIESEL	$6500		

IN "SAUCER TEST" RED LEAD PRIMER OUTLASTS *all others* 4 *to* 1

● Dutch Boy Red-Lead is a fine, highly oxidized red-lead supplied in two forms—paste and liquid. The paste comes in natural orange red, is readily mixed to brushing consistency and can be tinted to darker colors. Dutch Boy Liquid Red-Lead (ready for the brush) is available in the natural orange red, two shades each of brown and green, and also in black.

● If you've looked for proof, here it is . . . proof that pure red-lead is the durable primer for iron and steel structures! Read this brief account of an ingenious "Saucer Test" developed by the engineering staff of a southern railroad.

In this test, half of each small steel saucer is given a priming coat of Dutch Boy Red-Lead. The other half in each case is painted with one of the other paints to be tested. All saucers are filled with locomotive stack cinders and water, then placed on outdoor racks for a period of months with water added as it evaporates. The saucers are allowed to stand until the paints break down.

The "Saucer Test" offers an excellent way to test metal-protecting paints because it closely reproduces actual service conditions. The corrosive sulphuric acid reaction that takes place when cinders and moisture lodge in the webs and angles of metal structures is duplicated in the test saucers.

Scores of priming paints have been put through the "Saucer Test" by this one southern railroad. In every case . . . red-lead has outlasted every other priming paint by 4 to 1—or better! As a result, this railroad has standardized on pure red-lead for priming paint for metal structures.

Another railroad used a similar test with a salt solution to find the most durable paint for bridges exposed to brine drip from refrigerator cars. In this brine test, as in the cinder test, red-lead proved its unique value as a safeguard against rust and deterioration.

Why not make this practical, easy "Saucer Test" yourself? Prove to your own satisfaction that Dutch Boy Red-Lead will protect better against the corrosion that causes destruction. Let us send you a testing saucer and a sample of Dutch Boy Red-Lead ready for the brush, together with full directions for making the "Saucer Test". Just make your request on your company letterhead.

★

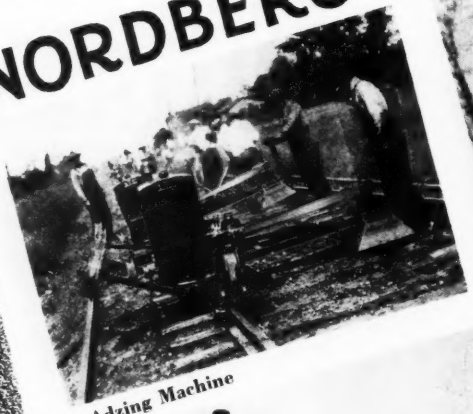
Saucer used to make "Saucer Test" for paint durability. Made of steel, 5½ inches in diameter by ⅝ inch deep. Write for testing saucer and sample of red-lead. Prove to yourself that Dutch Boy Red-Lead is your property's best safeguard against rust.

NATIONAL LEAD COMPANY

New York, 111 Broadway; Buffalo, 116 Oak Street; Chicago, 900 West Eighteenth Street; Cincinnati, 659 Freeman Avenue; Cleveland, 820 West Superior Avenue; St. Louis, 722 Chestnut Street; San Francisco, 2240 24th Street; Boston, National-Boston Lead Co., 800 Albany Street; Pittsburgh, National Lead & Oil Company of Pa., 316 Fourth Avenue; Philadelphia, John T. Lewis & Bros. Co., Widener Building.

DUTCH BOY RED-LEAD

NORDBERG MACHINERY----



Adzing Machine

Spike Puller

Rail Drill

Power Jack

Surface Grinder

Track Shifter

Cross Grinder

----will help put through your ECONOMY PROGRAM

Nordberg Track Maintenance Machinery promotes immediate as well as ultimate economies.

—by prolonging the life of rails now in track.

—by assuring much longer and better service from newly laid rails.

—by cheaper and better maintenance of switches.

NORDBERG MFG. CO.

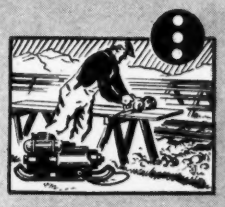
Railway Equipment Department

MILWAUKEE WISCONSIN

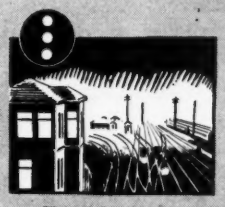
CLEAR TRACKS TO MAINTENANCE ECONOMIES

ARC WELDING TRACKS

PORTABLE POWER PLANT



PORTABLE POWER UNIT



FLOOD LIGHTING

ARC WELDING BRIDGES

ARC WELDING SAVED 1/3 IN STEEL *on this bridge*

THIS 175-foot arc-welded railroad bridge contains 80 tons of steel. The corresponding riveted design would have required 120 tons—½ more.

Arc welding also effects marked economies as compared with riveting for reinforcing or repairing old bridges, and for constructing signal bridges, bins, tanks, stand pipes, buildings, and miscellaneous structures.

For track maintenance many railroads have found arc welding the most economical method for building up battered rail ends, switch points, crossovers and frogs.

Westinghouse FlexArc welders for shop and field welding are available in ratings and types to suit every welding application.

FlexArc electrodes, a product of Westinghouse Research, are available in all commercial sizes.

This single-track, through-truss type bridge, constructed by arc welding, contains 80 tons of steel. Riveting would have required 120 tons.

Westinghouse also provides a complete line of arc-welding accessories including helmet, hand shield, improved metallic electrode holder, cable, scratch brush, carbon electrode holder, Flexactor, leather sleeve and gloves.

T 79097

Westinghouse

Quality workmanship guarantees every Westinghouse product

SEND FOR BOOKLET

Westinghouse Electric & Manufacturing Company
Room 2-N—East Pittsburgh, Pa.
Gentlemen: Please send me a copy of S. P. 1879, The Arc Welding of Structural Steel.

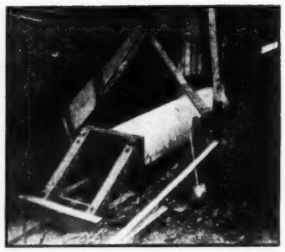
Name.....
Company.....
Address.....
City..... *State*.....REM 5-32

Significant facts mark the 36th ANNIVERSARY *of Corrugated Iron Pipe*

Throughout most of the interesting history of this remarkable drainage product, the name Armco stands out in bold relief, not only as that of a leading manufacturer, but as the name of a pioneer in the development of methods and materials in the interests of better and more economical drainage. Foremost among these achievements are:

1. ***The establishment of a complete engineering and research staff*** for the benefit of culvert and drainage product users and the development of a standardized program of culvert inspection and rating.

2. ***The development of the Armco Replacement Methods***—which save from 30 to 50% of replacement costs over alternate methods.



3. ***The designing of Armco Perforated Pipe*** for a wide variety of subdrainage purposes and particularly effective for railroad subdrainage problems.

4. ***The perfection of Armco Paved Invert Pipe*** which gives the three essentials for perfect culvert service—strength, durability and pavement in the bottom.

5. ***The designing of Multi-Plate Pipe***—the new large-diameter heavy duty culvert of superior strength.

6. ***The introduction of Armco Metal Cribbing***—which has brought new economies to the retaining wall field. Built up in standard formed sections for quick assembly.

These, and other outstanding accomplishments, make Armco both the pioneer and leader in railroad drainage. Complete information is readily available on any problem or product.

Armco culverts and drains are made from the Armco Ingot Iron of The American Rolling Mill Company and always bear its brand.

ARMCO Corrugated Iron PIPE

Other Armco Drainage Products

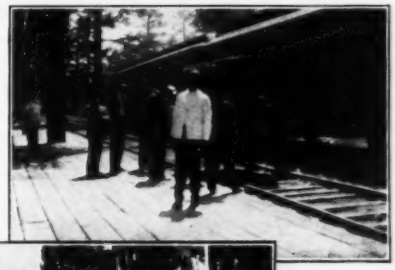
Automatic Drainage Gates
Part Circle Culverts

ARMCO CULVERT MANUFACTURERS ASSOCIATION ***Middletown, Ohio***

FROM THE RAILROAD FAMILY ALBUM SOME 25 YEARS AGO:

Sheffield No. 14 Motor Car on the Kearney Branch of the U. P. ready to start on track inspection —in 1906.

Two Sheffield Motor Cars on the El Paso and Southwestern R. R.



Sheffield No. 16 Motor Car at Grand Canyon, Arizona, on the Santa Fe.

Sheffield No. 15 making a trip over the Cal. & Northwestern from Tiburon, Cal.

SHEFFIELD TRESPASSED!

. . . but he prevented a wreck

Tapered Roller TIMKEN BEARING EQUIPPED

Just a few Sheffield "FIRSTS"

FIRST railroad gasoline motor car
FIRST to use four cycle engine in railway motor car
FIRST to use two cycle engine in railway motor car
FIRST water-cooled gasoline engine for railway motor cars
FIRST air-cooled gasoline engine for railway motor cars
FIRST belt-drive motor car
FIRST direct drive railway motor car
FIRST friction-drive railway motor car
FIRST clutch-drive railway motor car
FIRST to use pressed steel wheels
FIRST to use self-priming engine
FIRST railway section motor car
FIRST to make inspection car
FIRST gasoline passenger rail car

Back in 1875, George Sheffield built a velocipede for propelling himself over the rails of a line between his home and the shop where he worked. It saved this ingenious mechanic many steps and time—after dark when he dared use it.

Then one wintry night he discovered a broken rail and with a farmer's lantern flagged a freight train. And in the report of that train crew, railroading first learned of the first Sheffield Car.

Railroad men saw its advantages and purchased! Then in 1896 came another Sheffield Car—a car driven by a gasoline motor—self propelling.

Today Sheffield Cars, built for every need of railroading, travel the rails of the world.

So it was that Sheffield originated the first railway motor car—"First on the rails and still first." And out of the same Sheffield organization has come every major improvement that has lowered the over-all cost and increased the reliability of motor car operation.

FAIRBANKS, MORSE & CO.

New York
Baltimore
Chicago
St. Louis
St. Paul
San Francisco

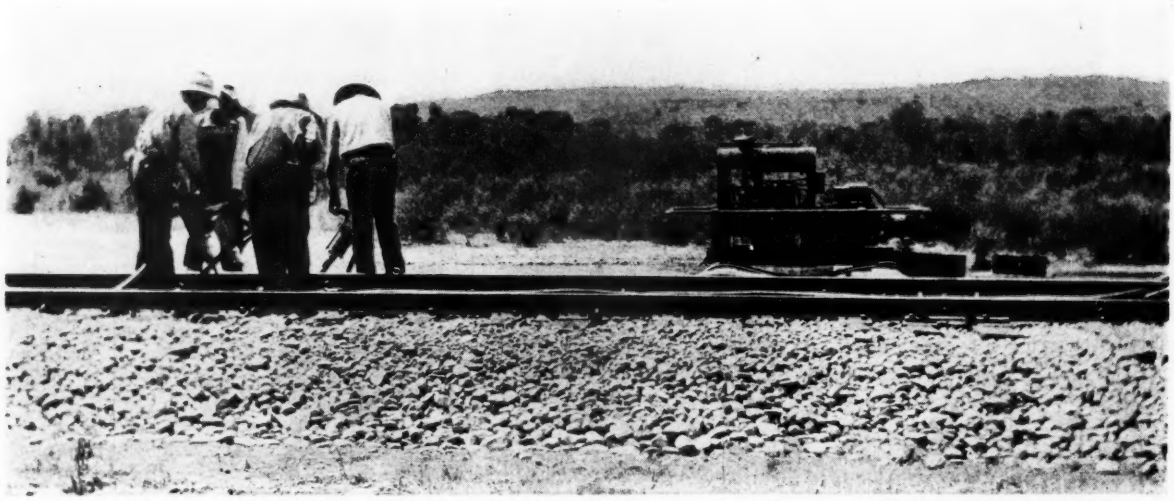
FAIRBANKS-MORSE

motor F M *cars*

FIRST ON THE RAILS — AND STILL FIRST

5681—RA21.84

ELECTRICITY IS THE MODERN POWER



OBSOLETE METHODS
HAND PICK TAMPING

4-TOOL UNIT

	TIME SHEET	Reg. Time	O. T.
1	John Jones, Foreman	8	hrs.
2	Gandy Dancer, Laborer	8	"
3	Gandy Dancer "	8	"
4	Gandy Dancer "	8	"
5	Gandy Dancer "	8	"
6	Gandy Dancer "	8	"
7	Gandy Dancer "	8	"
8	Gandy Dancer "	8	"
9	Gandy Dancer "	8	"
10	Gandy Dancer "	8	"
	Total	80	"

MODERN METHODS
SYNTRON ELECTRIC TAMPING

	TIME SHEET	Reg. Time	O. T.
1	John Jones, Foreman	8	hrs.
2	R. Syntron, Laborer	8	"
3	R. Syntron "	8	"
4	R. Syntron "	8	"
5	R. Syntron "	8	"
6	R. Syntron "	8	"
	Total	48	"

This Expense Saved by → **SYNTRON ELECTRIC TIE TAMPERS**

DECREASED EARNINGS NECESSITATE DECREASED EXPENDITURES

BUT

—EVEN WITH SMALLER FORCES—TRACK MAINTENANCE CAN NOT ONLY BE CONTINUED BUT EXTENDED BY USING

Modern Equipment AND Modern Methods

SYNTRON CO. PITTSBURGH, PA.

The Test of Dump Cars

Is their adaptability to all kinds of work and all working conditions. Western drop door cars are supreme in this respect. The illustrations show some of the uses to which they are suited.

Added to their adaptability are these fundamental characteristics:—absolute safety under all operating conditions; rugged construction; low upkeep; and low operating costs. They have low loading height, steep discharge angle, and the drop doors afford complete protection to track and ballast—features that are essential to successful, economical dump car operation in railroad service.

Western Dump Cars are built in all practical sizes and are for sale or rent. Write for particulars today.

1. Western Cars of 30 cubic yards capacity have made a remarkable record in grade revision on the Rock Island Lines.

2. Western 20-yard cars are reducing ditching costs to a minimum on the M. K. & T. A standard railroad ditcher can completely load a car of this size without using the bucket to push the material to the far end.

3. You will notice in this view that the dumping angle is very steep (fully 50°) insuring a clean discharge of the load. At the same time the car door prevents the dumped load from fouling the track or ballast.

4. Western Cars have always been noted for their great strength. They handle heavy rock as easily as they handle earth or waste material of any kind.

WESTERN WHEELED SCRAPER COMPANY

Dump Cars and Grading Equipment AURORA, ILLINOIS, U.S.A.

WESTERN

No. 41 of a Series

Railway
Engineering and Maintenance
SIMMONS-BOARDMAN PUBLISHING COMPANY
105 WEST ADAMS ST.
CHICAGO, ILL.

Subject: Ten Thousand Miles for 15 Cents

April 28, 1932

Dear Reader:

As you read the last issue of Railway Engineering and Maintenance, I wonder if it occurred to you to estimate how long it would have taken you to have visited the various projects described in that issue, or how far you would have had to travel to gather the information that was laid on your desk within the covers of that one issue.

You will recall that you would first have taken a trip on the rail flaw detector car operating on the New York Central between New York and Chicago to observe the construction of the car and the way it works. You would then have inspected the various service facilities which have been rebuilt and modernized on the main line of the Texas & Pacific between New Orleans, La., and El Paso, Tex. Next, you would have participated in a detailed field inspection of the creosoted foundation piling under various structures on the Illinois Central between Chicago and New Orleans. You would have studied an unusual solution of a track drainage problem in Northern Wisconsin; you would also have investigated the working of a novel safety stunt in Nebraska.

In addition to these extensive field investigations, you would have called upon a maintenance officer of the Pennsylvania to secure the results of an investigation of guard rails on bridges, made by a committee of which he was chairman, and would have talked with a track engineer of the Santa Fe to draw on his years of observation of rail failures and their import. You would also have visited 14 states and 1 Canadian province and would have traveled from New York to San Francisco and from Toronto, Ont., to Ragland, Ala., to interview the 26 men who contributed of their experience to the answering of questions in the What's the Answer department.

Thus, if you had attempted to gather personally the information contained in this one issue, you would have traveled thousands of miles and spent weeks of your time. Such is the scope of the review of developments in railway maintenance practices that we bring to you from month to month; yet it is made available to you for the expenditure of less than 15 cents a month.

Yours truly,

Elmer T. Howson
Editor.

ETH:EW

MEMBERS: AUDIT BUREAU OF CIRCULATIONS AND ASSOCIATED BUSINESS PAPERS, INC.

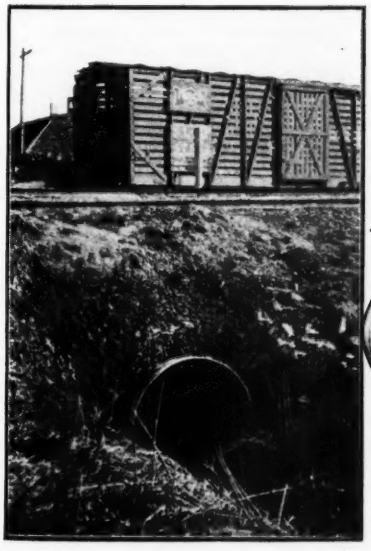
The "Pioneer," built in 1836 by Baldwin for Utica & Schenectady Railroad. Later sold to Michigan Central. Afterward in the possession of Galena and Chicago Union Railroad —now preserved by Chicago & Northwestern Railway. A fine example of inbuilt value.

REPEATED USE PROVES INBUILT VALUE

Every day railroads are doing the same thing with Toncan Iron Culverts that was done with this well built dependable old locomotive—using them over again when changes in road bed or methods of drainage are made. Only with long lasting culverts can this be done—culverts that resist the attack of rust—culverts that have retained their structural strength—and Toncan Iron Culverts do both.

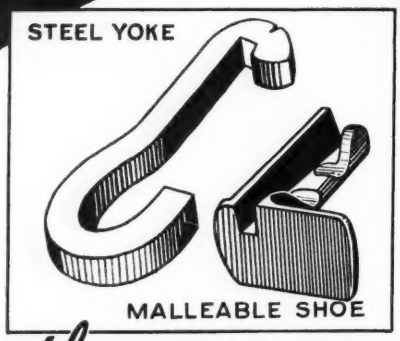
Toncan Iron is an alloy of refined iron, copper and molybdenum. It defies rust. It is uniformly resistant to corrosive attack throughout the entire thickness of the metal. It takes and holds a tenacious galvanized coating. Consequently it is longer lasting in service and more economical whether it is used permanently in one place or moved to new locations.

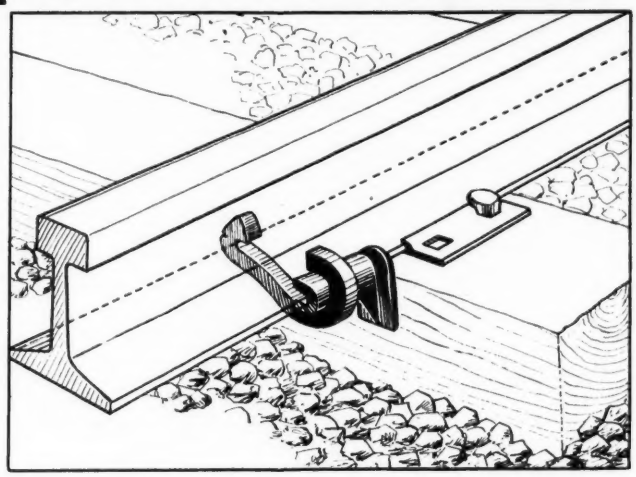
Railroads seeking the best value in culverts will find it in Toncan Iron. Write for a copy of the Toncan Culvert Handbook.



TONCAN CULVERT MANUFACTURERS' ASSOCIATION
YOUNGSTOWN, OHIO

2 PIECES FOR A PURPOSE





together THEY PROVIDE GREATER HOLDING POWER

The Ericson Rail Anchor was purposely designed in two separate pieces, consisting of a rugged malleable iron shoe and a heavy steel yoke.

This two piece patented design provides many outstanding advantages unobtainable in single piece rail anchors:

1—A frictional grip of greater holding power.

2—Unlimited reapplication without affecting efficiency.

3—Longer useful life.

4—Easy application and removal.

5—A constant positive pressure against the tie.

6—Unaffected by temperature or varying traffic conditions.

7—Applicable in case of variations in rail sizes.

8—Adjustable—removable—reusable.

There are no disadvantages in a two piece rail anchor—rather, there are many extra advantages that only a two piece design can provide.

ERICSON RAIL ANCHOR

INDUSTRIAL AND RAILROAD SUPPLY COMPANY

NATIONAL SALES REPRESENTATIVES

MANUFACTURED BY ILLINOIS MALLEABLE IRON CO.

310 SOUTH MICHIGAN AVE. CHICAGO

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215 Market Street

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Printed in U. S. A.

Railway Engineering and Maintenance

NAME REGISTERED U. S. PATENT OFFICE

MAY, 1932

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Waterways—Minor Details—Foundations

A Liability or an Asset - - - - - - - - - - 318
The extent to which roadway machines or tools are used determines into which of these categories they fall

Model Camp Trains on the Pennsylvania - - - - - - - 322
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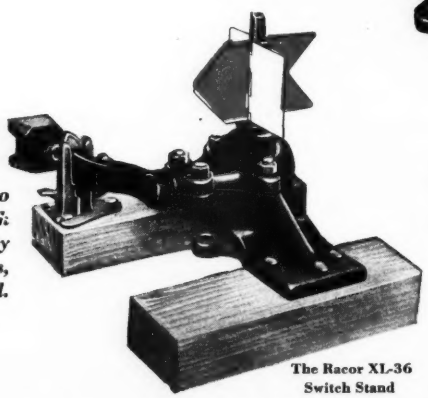

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Railway Engineering and Maintenance

WATERWAYS

A Threat to Every Railway Employee

THERE is now before Congress a bill known as the Shipstead-Mansfield bill, proposing the appropriation of $500,000,000 to speed up work on river and harbor improvements and especially on the development of inland waterways. This bill constitutes a double threat to every railway employee. It not only involves an increased demand on the federal treasury with a corresponding increase in the tax burden on corporation and individual alike at a time when a reduction in this load is so essential, but it also has for its purpose the extension of waterway channels and the inauguration thereon of barge transportation to divert traffic from the railways and further reduce railway employment.

The bill now before Congress has strong political support. The national administration is committed to a navigable waterway system of some 27,000 miles, involving the deepening of the Mississippi, the Missouri and the Ohio rivers and certain of their tributaries. As a corollary to this development, the government has created a corporation to engage in traffic on these channels for the announced purpose of determining the feasibility of commercial transportation and when this has been achieved, of withdrawing in favor of private operation. Although this experiment has now been in operation for six years, there is as yet no indication of any intention of withdrawal by the government. Rather, the bill now before Congress is designed to extend the ramifications of the waterway system widely.

Is There Economic Justification?

No project which would impose an added tax burden of the magnitude required under the terms of this bill should be undertaken until its merits have been proved beyond any reasonable doubt. Taxes took from the railways 7.24 cents of every dollar of revenue received last year. Figured on another basis, taxes took 31.63 cents of every dollar of railway net operating revenue, on which basis the railways of the country worked solely for the various governments, state, national and local, for more than 16 weeks of 1930. Yet Congress is now struggling to *increase* the income from taxation more than $1,000,000,000 a year.

Furthermore, the government has now been operating barge lines in competition with the railways for more than six years, a term sufficiently long to demonstrate their commercial possibilities. Yet at the end of this six-year period, these barge line operations have resulted in an admitted net deficit of $443,412. If to this amount be added $248,000, which the Inland Waterways Corporation has received in interest on public moneys appropriated and unexpended, its actual operations are seen to have resulted in a deficit of nearly $700,000 or more than $100,000 per year.

These figures include no return on the expenditures which the government has made to create and maintain navigable channels (the right of way and track), totaling hundreds of millions of dollars. Nor do they include any return on the $24,500,000 of public money which the government has advanced directly to the Inland Waterways Corporation to the end of 1930, the interest on which amounts to more than $1,000,000 annually. Neither do they include the expense for executive offices in Washington which, in 1930, totaled $57,614.24. Nor do they include the salaries of the chairman of the Inland Waterways Corporation and other officers, aggregating $24,054.60, all of which expenses are paid by the government. Neither do the government-owned barge lines pay any taxes, depriving the government of income which, at the rate paid by the railways last year, exceeds $400,000 a year.

These and other similar items of expense, which should be included to get the complete picture of the cost of this government-owned barge line operation but which are ignored in the reports given to the public, exceed $1,500,000 for the year, in contrast with a "net operating income" reported for 1930 of $65,177.09. Such is the bookkeeping employed to camouflage the real facts in an effort to justify this "noble experiment." These contributions from public funds, whether to pay admitted deficits, interest on investment or salaries buried in other accounts, constitute a subsidy to waterway transportation for the benefit of those using that agency, that is paid for by the public at large, including the railways and those who derive their livelihood from the railways.

When Will Experiment End?

It is the announced purpose of the government to engage in waterway transportation only until its economic justification can be demonstrated to the point that private capital can be induced to enter the field. To date two such companies have ventured into this field of transportation, one with an investment of something like $3,500,000 and the other of $2,000,000. Both of these companies are reported to be losing money. It is not surprising, therefore, that other companies are looking elsewhere for investment opportunities.

It is pertinent to inquire, especially in the light of the further large expenditures that are now being proposed,

how much longer this experiment is to continue and when it is to terminate. Furthermore, if the proposal is as purely experimental as its advocates contend, one might logically inquire as to the necessity for adding so largely to the investment until the expenditures already made demonstrate the feasibility of this form of transportation. Surely a waterway system of more than 2,000 miles, traversing areas of heaviest traffic in the Ohio and Mississippi River valleys, should afford a sufficient test without further commitments of the magnitude now proposed. Rather, the entire proposal bears marked resemblance to the camel which, permitted to thrust its nose under the tent, proceeds to force its entire body in, with the result that it soon crowds the other occupants out.

Waterway Competition Is Unfair

Not only are the waterways operating with heavy losses that are being made good by general taxation to which the railways and their employees, in common with the general public, are forced to contribute, but they are subjecting the railways to unfair competition in numerous ways. For illustration, the roads are forced to participate with them in joint rates, even where the traffic is required to move as much as 40 per cent out of route to get to the waterway. Furthermore, waterway rates are generally fixed at a level 20 per cent below those of the railways, and where traffic moves on a joint rail and waterway rate, the railway is forced to participate in this reduction in its division for the rail haul, even though it performs identically the same service that it would for a corresponding interchange with another rail line at the full rates. The barge lines are not only, therefore, competing with the rail lines on a lower rate basis, but are actually forcing the roads themselves to accept lower rates for the service which they are required to render the barge line. Such is the inducement offered the shipper to divert his traffic from the railways.

Furthermore, in this competition with the railways the federal barge lines are free from much of the regulation to which the railways are subjected, as, for instance, hours of service, selection of traffic, etc. Indicative of the extent to which this difference in freedom of action prevails, it was testified recently in open hearing that the barge lines are giving secret or contract rates to favored shippers, a practice which has long been outlawed on the railways and which, if indulged in today by railway men, would lodge them in prison. If the prohibiting of such practices and the enforcement of other restrictions are in the interest of the shippers and employees of the railways, they would appear to be equally necessary for the protection of the same shippers when they route their traffic over the barge line, and be equally to the interest of employees who handle this same traffic on the barge lines of inland waterways.

Entirely aside from the demonstrated lack of economic justification for the barge line from the standpoint of economy in the movement of traffic, and ignoring also the unfairness of the competition which the government subsidized barge line is forcing on the roads, the railway employee is vitally interested in a still further consideration. That is the effect on his own employment of a further diversion of traffic from the railways. That the effect is direct has been demonstrated most forcibly during the last three years. Beginning in 1929, the railways have been confronted with a constant and heavy decline in traffic and in earnings. They at first endeavored to stem the tide of business recession by maintaining and even adding to employment. They soon found, however, that they could not continue this practice and they have since been forced to reduce employment in line with their earnings. The effect is shown by the fact that the number of persons employed by the railways declined 502,000 from January 15, 1929 to February 15 of this year and that during the last year alone, the number of employees in the maintenance of way department decreased 19.93 per cent. Such is the effect of the volume of railway traffic on the ability of the railways to provide employment.

That the waterways constitute no idle threat to the railways is shown by the traffic now being handled by the government-owned barge line on the Mississippi river between New Orleans and St. Paul. On this line an average of 97,598 tons of freight was handled monthly during 1931. On the basis of an average of 20 tons per car, this was sufficient to have loaded approximately 4,900 cars per month or 200 per working day. This is not a large traffic in itself but it was sufficient to yield a gross income for the barge line of more than $6,000,000—a traffic which, if it had been handled by the railways, would have resulted in an increase in their payrolls of at least $3,000,000. Large as these figures are, the real menace lies in the extension and enlargement of this service contemplated in the bill now before Congress. This bill, if passed, will greatly increase the mileage of waterways on which it will be possible to operate barge lines and will likewise increase the possibility for the further diversion of traffic.

"Things Are Getting Better in This Country"

"Down here in the Reconstruction Finance Corporation we are in a position to know that things are getting better in this country—in a damn sight better position to know what is going on than are those fellows in that security peanut stand in Wall street.

"Bank failures are falling off. The banks are beginning to make loans again. It makes no difference what Wall street thinks down there where that peanut gambling is going on.

"You can take it from me we are approaching prosperity. The mass attitude of the people has changed from pessimism to optimism, but, of course, it will take time to realize the full results. Business is a ponderous machine and takes time to get in motion."

From a statement made by General Charles G. Dawes, president of the Reconstruction Finance Corporation, before the Ways and Means Committee of the national House of Representatives at Washington, D. C., on April 21.

Some Logical Requirements

Because of their very direct concern in the waterway policy that is to be followed, railway employees should interest themselves to insure that this policy will be founded on a sound, economic basis. Such a basis would include the following considerations:

(1) Since the development of our waterways as trans-

portation agencies is still admittedly experimental, there should be no further expenditure of public funds for the extension of this system of transportation until such time as the installation already in operation demonstrates its economic feasibility.

(2) Since the government is engaged in the operation of barge lines on the Mississippi and other rivers in competition with the railways only for the announced purpose of determining whether such operation can be made commercially profitable and since this experiment has now been in progress for six years, the government should be able to arrive at a conclusion and terminate the experiment within two more years. Eight years should be sufficient to demonstrate whether the operation can be made sufficiently profitable to attract private capital into this activity.

(3) So long as barge lines are operated on the waterways under either government or private ownership in competition with the railways, they should be subjected to the same regulation and by the same body, not only to protect the railways against unfair and unregulated competition, but also to insure that the shipper shall receive the same protection and the same high degree of service from both agencies of transportation.

(4) So long as the waterways are maintained as transportation agencies, the railways, as the principal carriers of the nation's commerce, should be given the right to engage in transportation on these waterways in common with other carriers in order that they may be enabled to offer their patrons such advantages, if any, as are afforded by waterway transportation.

MINOR DETAILS

Small Defects Contain Germ of Large Damage

OWING to the limited size of existing section forces there is a danger that some of the minor details of maintenance may be passed over or neglected completely, in the belief that the time required to attend to them can be employed more productively in other work. The rail joint is a case in point. To maintain a rail joint properly it is necessary to give close attention to a large number of seemingly minor details, most of which when taken singly appear to be relatively unimportant.

When other matters are pressing and the force is limited, the tendency is to pass over small defects, particularly if they have no immediate bearing on the safety of the track. On the other hand, the alert foreman is aware that the various details of joint maintenance are so interdependent that none of them can long be neglected without having an adverse effect on all of the others.

To cite one example only, neglected bolts nearly always result in pumping joints. These, in turn, damage the joint ties and this affects the line and surface. Singly or in combination, these defects cause rail batter, wear on the fishing surfaces of the joints, surface-bent rail, surface-bent or broken angle bars and, in some cases, water pockets in the roadbed. Thus the results of the apparently small initial neglect go out in ever widening circles of damage to roadbed and track, and the failure to apply a stitch in time may eventually make it necessary to apply many times nine.

The joint was taken only as an example. There are many other items included in track maintenance, in which initially small defects cannot be ignored with impunity. It is essential, therefore, that, regardless of present conditions, they be given attention as they develop to eliminate the eventual damage of which they are the germ.

FOUNDATIONS

Economical Design Demands Full Field Facts

A PAPER recently presented on the history of modern building construction directed attention to the fact that it was not until about 50 years ago that even simple arithmetic was used in the design of spread foundations; that is, to determine footing areas by dividing the calculated loads by an assumed allowable pressure per square foot. In these days it is hard to understand why so simple a procedure had not been followed previously, but we must remember that structural design as it is understood today is only about 80 years old and that "judgment" was superseded by calculations very slowly in proportioning the parts of a bridge or building. Judgment, however, still enters largely into decisions on foundations.

To determine the reason for this it is necessary to consider what is meant by judgment in this connection—the intelligent application of accumulated experience with respect to problems that cannot be solved by mathematics because the necessary physical facts are not accurately known. Test of the materials of construction have developed sufficient data concerning their physical properties so that judgment now plays only an indirect part in structural design, but because of less complete knowledge concerning the behavior of soils, because foundation conditions are so variable and because the detailed investigation of a bridge or building site costs considerable money, judgment still enters largely in the decision as to the type of foundation and the allowable bearing pressure.

In spite of this, foundation failures are infrequent, but as pointed out by J. J. Yates in the paper abstracted on page 327, engineers are prone to use low bearing values. In other words, lack of accurate information leads them to be conservative, with the result that foundation work is often more expensive than it would be if the safe bearing value of the soil was fully developed in the design. What the man in the office can do to produce an economical design depends on the completeness and accuracy of the foundation information furnished him by the men in the field. This, however, imposes a serious problem on the field man because he must decide how much money he can afford to spend in making his investigation and he is not usually encouraged to go very far. Mr. Yates' paper does not answer this question directly, but it does review the things that can be done to get the facts, and the emphasis which it places on a thorough investigation should prove helpful to anyone who is anxious to get authority for a thorough study.

A Liability or an Asset?

Roadway machines or tools can be either, depending on the extent to which they are used

AS SOON as a railway begins to acquire work equipment it becomes of first importance to adopt means which will insure the fullest use of the individual machines and the maximum return from this use. In the belief that a discussion of the measures that have been devised by different roads to insure the intensive use of work equipment will be of interest and help, an inquiry was addressed to a number of representative railways, asking them how they assign their equipment and supervise its use; what effort is exerted to keep it working; the nature of the organization that is responsible for its maintenance; and what experience has indicated to be a reasonable percentage of working time for the various types of work equipment units. Replies to the questions were received from 44 roads operating 164,000 miles of lines.

The first step toward greater use lies in the distribution and assignment of the individual units. Different railways accomplish this in different ways, all with the one purpose, however, of assuring a maximum amount of use during the year for the more general types of machines, or during the working season for the more specialized types.

Obviously, motor cars are permanently assigned to individual sections, to bridge and building and other regular gangs and to extra gangs. The smaller power units, together with their complement of power tools, such as tie tampers, portable compressors and generators for bridge gangs and other similar units; small rail cranes, locomotive cranes, bridge derricks, etc.; concrete mixers, hoisting engines and many other types of small equipment which are used regularly by the maintenance forces, are usually assigned permanently to the divisions, since the division forces can generally keep them busy the major part of the year. Division engineers, roadmasters and supervisors are charged with the responsibility of using them as intensively as practicable.

More Important With Larger Machines

Since the larger units represent, individually, a much larger investment and have a higher rate of depreciation and obsolescence, it becomes of still greater importance that they be used to the maximum practicable extent. Furthermore, since the individual operating divisions of a railway seldom have sufficient work to keep them busy during the entire year, their distribution is generally made from the system standpoint and they are assigned by the chief engineer or engineer maintenance of way.

Rail Cranes May Have Many Uses

On the Atchison, Topeka & Santa Fe, the Chicago, Burlington & Quincy, the Pennsylvania, and several other large roads, the chief engineer or engineer maintenance of way distributes this equipment to the several regions or grand divisions in accordance with a definite schedule which is prepared to correspond to their needs. The ranking officer of the territory to which it is sent then makes the assignments locally and supervises its use. This method of distribution does not apply to pile drivers or heavy bridge derricks for which on these and many other roads the assignment is made for the system by the bridge engineer.

On a number of roads, other than those mentioned, the chief engineer or engineer maintenance of way assigns the larger units directly to the divisions for the period necessary to complete the work they have to do, and keeps a record of the location of each unit, moving it from point to point in accordance with a definite schedule. In some instances this schedule is placed in the hands of the supervisor of work equipment and it is delegated to him to see that the use of the various units conforms to the schedule.

Follows a General Program

On the Gulf Coast Lines, a general program for the distribution of the larger units of work equipment is prepared at the beginning of the year and the details of carrying out the assignments are then handled by the supervisor of work equipment. This program is modified from time to time as the season advances to conform more nearly with the current progress of the work, taking into account unexpected conditions which may have arisen. The exact distribution for the following period is decided after discussion in the monthly staff meetings. On the other hand, the Missouri Pacific prepares its program on a monthly basis on the first of every month, in which the use of each unit of equipment is scheduled for the ensuing period. Two roads, the Norfolk & Western and the Northern Pacific, have no special organization for distributing their work equipment. On the former, both the assignment and the supervision of the units while in use are placed in the hands of the division roadmaster, while on the latter, the entire engineering organization is keeping careful watch to see that the equipment is used as intensively as practicable.

A somewhat different system is in effect on a number of other roads, which organize system or regional extra gangs to perform such special work as laying rail, ballasting, ditching, etc. On these roads, while motor cars and other of the units already mentioned are assigned to the divisions, each of the extra gangs receives an assignment of the special types of equipment which it needs to accomplish the work it is to do. Under this system intensive use of the equipment is assured for a maximum time during the year. Typical examples of roads following this practice are the Bangor & Aroostook, the Chicago & North Western and the Chicago, Milwaukee, St.

Paul & Pacific, while the Delaware, Lackawanna & Western expects to institute a similar system during the present season. On the Alton, the two division engineers are located in the same office, and experience has demonstrated that they are able to distribute between them the work equipment with which this road is supplied. So far as practicable, the Central of Georgia assigns all of its machines to individual divisions, which retain them as permanent division equipment.

On the Central of New Jersey the various units are assigned to track supervisors and bridge and building foremen, who report to the division engineers on the use and condition of the equipment, and the results they obtain from its use. These results are compared with those of similar machines elsewhere on the system to insure that the maximum benefit is being obtained from each unit of equipment.

There are numerous variations of these major schemes, which are given only in outline, and the details differ rather widely as between roads, but these examples indicate in a general way the methods that are being followed. In contrast, a number of roads have not devised any special methods of making the assignments, but shift the equipment as needs arise. All of them maintain, however, that they are watching closely the operation of their equipment to minimize the possibility of lost motion in its use.

Practically all of the roads from which replies were received, stated that they have instituted systems of daily or weekly reports, or both, to show the performance of each unit, its condition, the progress of the work it is engaged in, and how nearly the status of this work conforms to the schedule. This enables the head of the department, and other officers who may be interested in its use, to know currently what the situation is with respect to all of the equipment in service. This knowledge also permits a quick redistribution to be made of certain units, if this becomes necessary, without disrupting the general plan for the year.

Field Supervision

Having perfected methods of distributing the equipment, the next step is to devise a system of supervision which will insure that each unit will be used in a manner that will yield the maximum return on the investment. Such a system should include supervision over the machines that are assigned permanently to divisions as well as the larger units which are scheduled. To obtain maximum benefits, every unit must be kept in good repair and used as nearly continuously and as nearly to capacity as practicable. This cannot be accomplished, however, without operators who are educated to handle their machines so that they will not be subject to abnormal wear or breakdown. They should be taught to operate the equipment in such a way that it will produce the maximum output of which it is capable. They should also be instructed not to overload the equipment or use it for tasks for which it is not adapted. Delays to the work as a result of improper operation or misuse may cost far more than the actual repairs or replacement of parts, while their effect may be felt throughout the remainder of the season's schedule. In other words, no single mistake can compare in its effects with that of choosing a poor operator.

To provide for field supervision which will insure that the equipment is kept working and is properly operated and maintained, many roads have organized a special department, at the head of which they have placed a supervisor of work equipment. This officer is charged with the duty of keeping all machines at work as intensively as practicable, of instructing operators and of making or supervising all running repairs as well as major repairs. In short, he is given direct charge of all work equipment and is responsible for its use and maintenance, with a view to obtaining the best results from the investment which it represents. On many roads he supplies all operators, except for the smaller units which are assigned permanently to the divisions, and must know that any man who is placed in charge of a machine is qualified to handle it.

Work Schedules Are Important for Power Jacks

Tractors May Be Employed on Various Jobs

Maintenance and Repairs

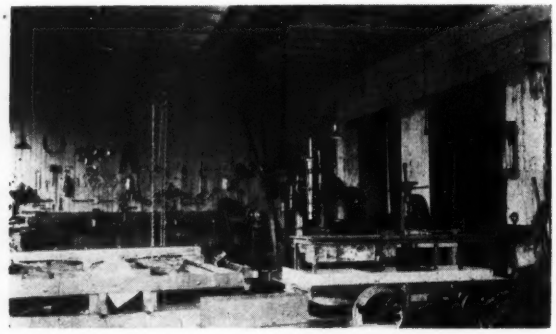
Practice varies widely with respect to the methods that are followed for making the field repairs and handling the annual maintenance. There are only a few roads which do not have special organizations for maintaining motor cars, including field repairs and the heavier maintenance in the shop. A number of roads have expanded this organization to include some or all power machines, while on others no expansion has been made.

As to power machines, on some roads all repairs, both in the field and in the shop, are made by the mechanical department. On others this is the duty of the maintenance of way department, and in numerous instances special well-equipped shops for this purpose have been established at one or more points on the system. On still others, field repairs to all equipment and the general overhauling of the lighter machines are done by the roadway department, while the heavier machines are turned over to the mechanical department for general repairs. A few roads require the mechanical department to maintain all steam equipment, but put the responsibility for maintaining gasoline and oil-powered units up to the maintenance of way department.

On the Alton, the mechanical department makes all repairs under the supervision of the division engineers, who inspect the equipment and list the work that is to

be done. Substantially the same method is followed by the Atchison, Topeka & Santa Fe, except that the supervisor of work equipment is in charge. Similar methods are in effect on the Bessemer & Lake Erie, the Denver & Rio Grande Western, the Mobile & Ohio, the Seaboard Air Line and the Wabash. On the latter road the mechanical department assigns special mechanics, who are skilled in this class of repairs, to do the work under the directon of the supervsor of work equipment.

Among the roads upon which the maintenance of way forces make all field repairs, the Central of Georgia requires each operator to keep his machine in good condition at all times. The Chicago, Burlington & Quincy also makes its operators responsible for the condition of the equipment while in the field. On this road the heavy



A System Motor-Car Shop

repairs are centralized in one mechanical department shop, where a foreman is specially assigned to work under the direction of the supervisor of work equipment. The Chicago & Illinois Midland has developed a system of traveling mechanics who make all repairs in the field as occasion arises.

Special Shops Are Provided

A system of road mechanics for making field repairs has also been established on the Chesapeake & Ohio, the assignment of this force being made by divisions in accordance with the number of units of all classes in service. Facilities for general overhauling and heavy repairs are provided in a special maintenance-of-way-shop. The Chicago, Rock Island & Pacific is a typical example of a road which has expanded its organization from one which was established to maintain motor cars to include the maintenance of all classes of work equipment.

The maintenance of way department of the Pennsylvania is also well organized to maintain its work equipment, of which it has a large number of units. Each region of this road has a supervisor of work equipment who has a force of field repairmen to make running repairs and keep the machines in operation. Machine operators are required, however, to look after the equipment in their charge and make such light repairs as are necessary. Special shops have been established at Renovo, Pa., and Ft. Wayne, Ind., to which the equipment is sent for general overhauling and heavy repairs. Similar methods with some variations are in effect on the Gulf Coast Lines, the Kansas City Southern and the St. Louis Southwestern, each of which maintains special shops for repairing this class of equipment.

Variations of these two major systems of maintaining work equipment are numerous. On some roads the mechanical department maintains all equipment which comes under M. C. B. rules and the roadway department maintains the remainder. On others the engineering department maintains all gas and oil-powered units and small tools, but turns the steam equipment over to the mechanical department for attention. Still others make a distinction between heavy and light equipment and assign the maintenance on this basis. Substantially all of these roads, however, have established special shops under the direction of the engineering department and have equipped them with machine tools and other facilities in number and character to correspond with the work that must be done.

The New York, New Haven & Hartford, one of the pioneers in the use of work equipment, has, according to E. E. Oviatt, chief engineer, "a complete force for maintaining work equipment. The supervisor of work equipment has in his organization inspectors, field and shop repairmen, operators of special equipment and an office force to keep all records. Heavy repairs, however, are made in the mechanical department shops under his direction." "On the Norfolk & Western," said W. P. Wiltsee, chief engineer, "The equipment is repaired by the division supervisors of bridges and buildings, each of whom has a sufficient number of mechanics and helpers, together with one motor-car repairman, to handle all work that is needed. When major repairs are required, the equipment is sent to the general shops and the work is done under the direction of the superintendent of motive power."

Roadway Department Maintains Oil-Powered Units

A. F. Blaess, chief engineer, Illinois Central, stated that, "Our gasoline equipment, except draglines, is maintained in division repair shops which are under control of the maintenance of way department. Draglines and steam equipment are maintained by the mechanical department." Similarly, G. A. Phillips, chief engineer of maintenance, Lehigh Valley, said that "Most of our work equipment is repaired at our Weatherly shops, except locomotive cranes which are handled by the mechanical department. All of our gas engines are very carefully maintained. To do this work we are equipped with cylinder-boring machines and machines for grinding valves and valve seats." According to H. S. Clarke, engineer maintenance of way of the Delaware & Hudson, each division on that road "has electrical and gasoline-engine mechanics who make running repairs as necessary. For general overhauling, the machines are sent to our main shops where the machine operator or the supervisor of work equipment, or both, oversees the work." A. C. MacKenzie, engineer maintenance of way of the Canadian Pacific Eastern Lines, advises that "M. C. B. equipment is maintained by the mechanical department. Other equipment is maintained by the division to which it is assigned, except for general overhauling, when the district maintainer assumes jurisdiction."

No single feature connected with the handling and use of work equipment compares in importance with that of keeping it at work for the maximum practicable period during the year. All of the efforts that are exerted to arrive at an ideal method of distribution, the provisions that are made to secure adequate supervision and the facilities that are provided for maintenance, have the same goal in view—maximum effective use.

Simple computations should show how many days any specific type of machine must be used during the year if its ownership is to represent a profit. On the other hand the replies to the questionnaire indicate that maintenance officers are not in agreement as to what constitutes a reasonable percentage of working time for various units of equipment.

This can be explained in part by climatic conditions,

in part by the difference in the character and amount of work that is to be performed and in part by the fact that some roads have a larger percentage of specialized machines than others. Because of climatic conditions, the Temiskaming & Northern Ontario is able to average only 100 days of working time for its equipment, while the same units on southern roads can be used practically every working day in the year. Again, one road may be able to complete its pile driving in 150 days with one machine, while another road may have enough work to require the use of two or three pile drivers for 250 or more days.

As a basis for computing the dividends which accrue from the use of work equipment, the Illinois Central has calculated the minimum number of working days for which the various machines must be employed in order to pay the fixed charges for the year. An accurate record was kept of the performance of the various machines and of the cost of their maintenance and operation. The cost of both running repairs and heavy maintenance were included in the fixed charges, together with interest, depreciation and obsolescence. After deducting the cost of operation from the savings which were obtained, it was found, for example, that it must work air compressors a minimum of 20 days to offset the carrying charges for the year. Similarly, the savings which result from the use of ballast discers are so large that they equal the fixed charges in 8 days. In like manner it was found that these charges can be met in 9 days with bonding drills; while rail cranes must be worked 30 days; tie adzing machines, 30 days; grinding machines, 30 days; dragline excavators, 27 days; tie tampers, 30 days; and tractors, 16 days.

Actual Service Obtained

In general, locomotive cranes and ditching machines, particularly if the latter are of the crawler type, are used a greater percentage of the time than other types of heavy equipment. While one road gets only 150 days' service from its locomotive cranes, and another averages 200 days, the remaining replies indicated that nearly all roads are getting from 250 to 300 days of service. Likewise, according to the information given, the period of active service for ditching equipment, including power shovels and draglines, ranges from 100 to 285 days, with most of the roads employing them in excess of 200 days.

Intensive use is also made of small capacity cranes. Although a few of the smaller roads report that they are able to use rail cranes only 90 to 100 days, others report from 180 to 270 days, while cranes of the full-revolving type are kept in service as much as 250 to 270 days. Tie tampers are usually considered to be a seasonal type of equipment; yet they are being used variously from 150 to 175 days a year, which compares favorably with the use that is being obtained from some other types of equipment that are not seasonal in character. One road reported, however, that it is using this equipment only 40 days a year, while another road stated that, in addition to tamping ties, it is obtaining an average of 60 days' use in other service from each unit.

Of the larger machines, ballast cleaners are being employed for periods ranging from 150 to 220 days a year, while spreaders and spreader-ditchers assigned to maintenance service are being used from 108 to 200 days, with an average of 150 to 160 days on a number of roads. One road which has an enviable record for the intensive use of work equipment stated that it was using its spreaders "as needed."

Portable air compressors and generators in bridge and building service are given intensive use on most roads, the average time reported being from 240 to 250 days.

It is to be expected that such special and seasonal machines as weed burners, weed sprayers, mowing machines, etc., will be used a less number of days than those which have a wider application. This assumption is borne out by the replies, which showed an average use of 75 to 90 days for weed-destroying equipment on northern lines. On southern lines, however, this time is greatly increased. C. E. Weaver, assistant general manager and chief engineer of the Central of Georgia, stated that, "In our section of the country the use of weed burners, mowing machines and discers is necessary about nine months out of the year." E. A. Craft reported that the Southern Pacific Lines in Texas and Louisiana, of which he is engineer maintenance of way, find it possible to use mowing machines 210 days; weed burners, 255 days; and ballast discers, 225 days.

Pile drivers are probably the most highly specialized of the larger units, since they are adapted for only one kind of work. Yet only one road reported less than 200 days' employment for this equipment, while the maximum was 270 days. Another special type of equipment which receives intensive use is welding equipment. The reports indicated that equipment of this type is being used from 270 to 300 days a year, which is the highest average employment for any type for which information was given. Tie adzers were reported as being in use an average of 150 days, while bolt tighteners ran as high as 270 days. Concrete mixers showed the widest spread between the maximum and minimum amount of use, only two roads reporting on this equipment. One of these roads is getting only 10 to 25 days' use from its concrete mixers, while the other is employing its mixers an average of 300 days a year.

Overhauled Machines Ready for Use

While a number of instances were reported in which the work equipment is being used almost to the practicable limit of the possibilities, one road reporting that it is using some of its machines two shifts a day to insure maximum return from the investment, it is manifest from the replies that few, if any, maintenance officers are satisfied that they are getting all of the service possible from work equipment, except in these few special cases. It is equally manifest that they are giving serious thought to methods that will result in a more intensive use of the equipment they now have, as well as that which they contemplate adding in the future. In short, these officers are alive to the fact that charges for interest, depreciation and obsolescence continue while a machine is idle, while profits are earned only while it is at work. A more extensive discussion of the utilization of work equipment will be found in the article which appeared on page 174 of the March issue, which was based on replies received to the same questionnaire.

One of the Heavy Maintenance Trains on the Move With the Track Forces and Equipment Intact

Model Camp Trains on t

Many advantages seen in providing heavy maintenance gangs with housing equipment embodying many modern conveniences

DURING the last three or four years the Pennsylvania has gone into the use of specially organized heavy maintenance gangs, of necessity quite large, for carrying forward out-of-face such heavy items of maintenance work as rail and tie renewals, ballasting, surfacing, etc. With this practice, the effectiveness and economies of which have been pointed out in previous articles, the Pennsylvania has taken another important step—the organization and construction of what are known as heavy maintenance trains, to be used as counterparts to the special heavy maintenance organizations. These trains, the first of which were constructed and put in service in 1930 after a thorough study of best practices on the Pennsylvania and on other roads, are designed to provide mobile bases for the special repair gangs, with all of the features found desirable for such bases, including suitable cars for the storage and transportation of the many power tools and roadway machines with which the gangs have been equipped, suitable office and living facilities for the general foreman in charge, and clean, sanitary and comfortable living quarters for the men.

At the present time, one or more of the heavy maintenance trains are assigned to each of the regions of the road so that, as current conditions require, it is possible to keep them and their organizations intact throughout the year, laying rail during the winter and spring months, and then shifting over largely to out-of-face tie renewals, surfacing and other major operations for the balance of the year. As operated, the trains are moved from point to point by work-trains, usually those employed in carrying out the work of the track forces, and are set out at the different points on sidings, yard tracks or vacant storage tracks as near the site of the work as possible. Because of the proximity of such tracks on many divisions, the trains are seldom more than two or three miles from the scene of the work. In most cases, the men are taken to and brought from work by the work-trains assigned to the work, but in some cases where work-trains are not regularly employed in carrying out the track work, the men are transported on motor cars and trailers, which form a part of their regular equipment.

General Make Up of Trains

While built and fitted in different company shops and at different times, and while differing in certain minor details, all of the heavy maintenance trains were constructed and equipped according to the same general specifications and plans. Therefore, a description of one of the trains will suffice to give a general idea of the features embodied in all of them.

The train described is used on the Central region by a force of trackmen which has been engaged at different times in carrying out rail renewals and tie renewal and surfacing work. This train is made up of the following cars: A flat car for transporting heavy units of equipment, such as air compressors, rail cranes and tool boxes over long distances; a box car specially fitted with bins, racks, shelves and drawers and used essentially as a tool car; two dining and kitchen cars constructed from rebuilt coaches; four or more sleeping cars of the coach type, rebuilt and refitted for the purpose; a general utility car, with recreation facilities and a separate foreman's room, which is a rebuilt coach; and a commissary car of the box-car type, which is fitted with suitable shelves and racks for the storage of all supplies handled by the train commissary. This entire train was built up as a unit, and each car assigned to the train was completely overhauled, rearranged inside and refitted to meet best the purpose for which it was to be used. Furthermore, all of the cars were completely repainted inside and out, the exterior color being standard box-car red with car numbers in white.

While each of the cars in the train embodies a number of special features, the dining and sleeping cars are of particular interest because of the evident effort in their design and equipment to make them roomy, comfortable

and sanitary. The dining cars, which are Pennsylvania PK coaches, with enclosed vestibules, have an inside length, exclusive of the vestibules, of 52 ft. 7½ in., and an inside width of 8 ft. 7½ in. These cars are divided transversely into two main sections, a dining room, approximately 34 ft. long, and a kitchen, about 18½ ft. long, with a wooden partition between them, carried to the ceiling and fitted with a swinging door with a glazed upper panel.

As shown in the accompanying sketch, the kitchen compartment is equipped with two 36-in. by 36-in. closets, with suitable shelving; a 36-in. by 48-in. serving table, with suitable drawers; a 30-in. by 66-in. coal range, with direct and indirect draft; a 24-in. by 30-in. sink, with a 24-in. by 36-in. drain board at one end over a coal box; a 24-in. by 60-in. kitchen cabinet; an 18-in. by 18-in. by 63-in. metal-lined storage bin; a 250-gal. overhead water storage tank, near the vestibule end; a 30-gal. range boiler tank, located over the sink; two electric air circulating fans, one near each end of the kitchen; two electric air exhaust fans, one on each side of the kitchen; a hand fire extinguisher; a 100-cu. ft. electric refrigerator unit; and a 10-gal. drinking water tank equipped with a cooling coil. These facilities are located along the two sides of the car, with ample working space between them, and are of such size and arrangement that daylighting of the kitchen is obtained through five window panels. The compressor for the refrigerating unit is housed on one side of the vestibule just outside the kitchen.

In the dining room compartment, which will accommodate 32 men at one time, the main facilities include a dining table, 36 in. wide by 28 ft. long, covered with white oilcloth; 16 stools, 18 in. high, for use along one side of the table; a metal-lined storage bin, 18 in. wide, 18 in. deep and 33 ft. long, divided into suitable compartments, which is built in along one side of the car and used for seating 16 at the table; a standard caboose car stove for heating purposes; a standard caboose car coal box; two air circulating fans, one at each end; and three upper sleeping berths of the Pullman folding type. These berths, two of which are at the kitchen end of the room, are used by the commissary help. Aside from the facilities mentioned, the dining room is unobstructed throughout, and is, therefore, fully daylighted by all of the windows along both sides of the car.

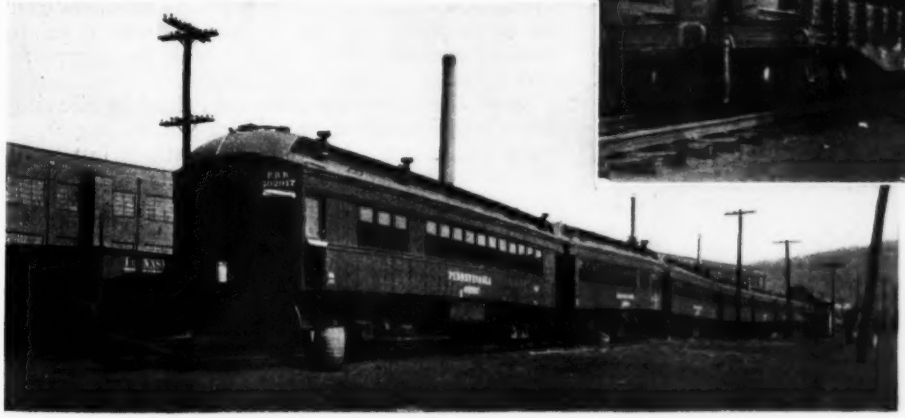
Showers Provided in Sleepers

The sleeping cars in the train are of the same type of coaches as the dining cars, but with about one-half of each car given over to a bunk room, while the other half is used as a wash, locker and shower room. In the sleeping compartment, which is closed off from the locker compartment by a full partition and a swinging door, there are eight double-deck steel bunks, each 2 ft. 6 in. wide by 6 ft. 2 in. long, grouped together in two rows through the center of the compartment, with passageways along both sides and at each end of the compartment. The only other facilities in this part of the car include a standard caboose car stove and coal box, two overhead electric air-circulating fans and two electric air-exhaust fans. This uncongested arrangement, with the bunks through the center of the car, provides for ample circulation of air throughout the sleeping compartment and unobstructed side aisles for the men to dress and undress in.

In the wash and locker section of the sleeping cars are sixteen 18-in. by 18-in. steel lockers, seven along one side of the car, five along the other side, and four in the center; four 8-in. by 24-in. lavatories, with mirrors above, two on each side of the car; two Kaustine chemical toilets and two shower baths, one of each on each side of the car; two 30-gal. range boilers located near the ceiling; a Holyoke double-coil water heater located on one wall; an overhead water storage tank of 350 gal. capacity; a standard caboose car stove and coal box; a fire extinguisher; and a stretcher box located over one of the rows of lockers. Five of the windows in this section of the car are unobstructed and afford daylighting of the compartment.

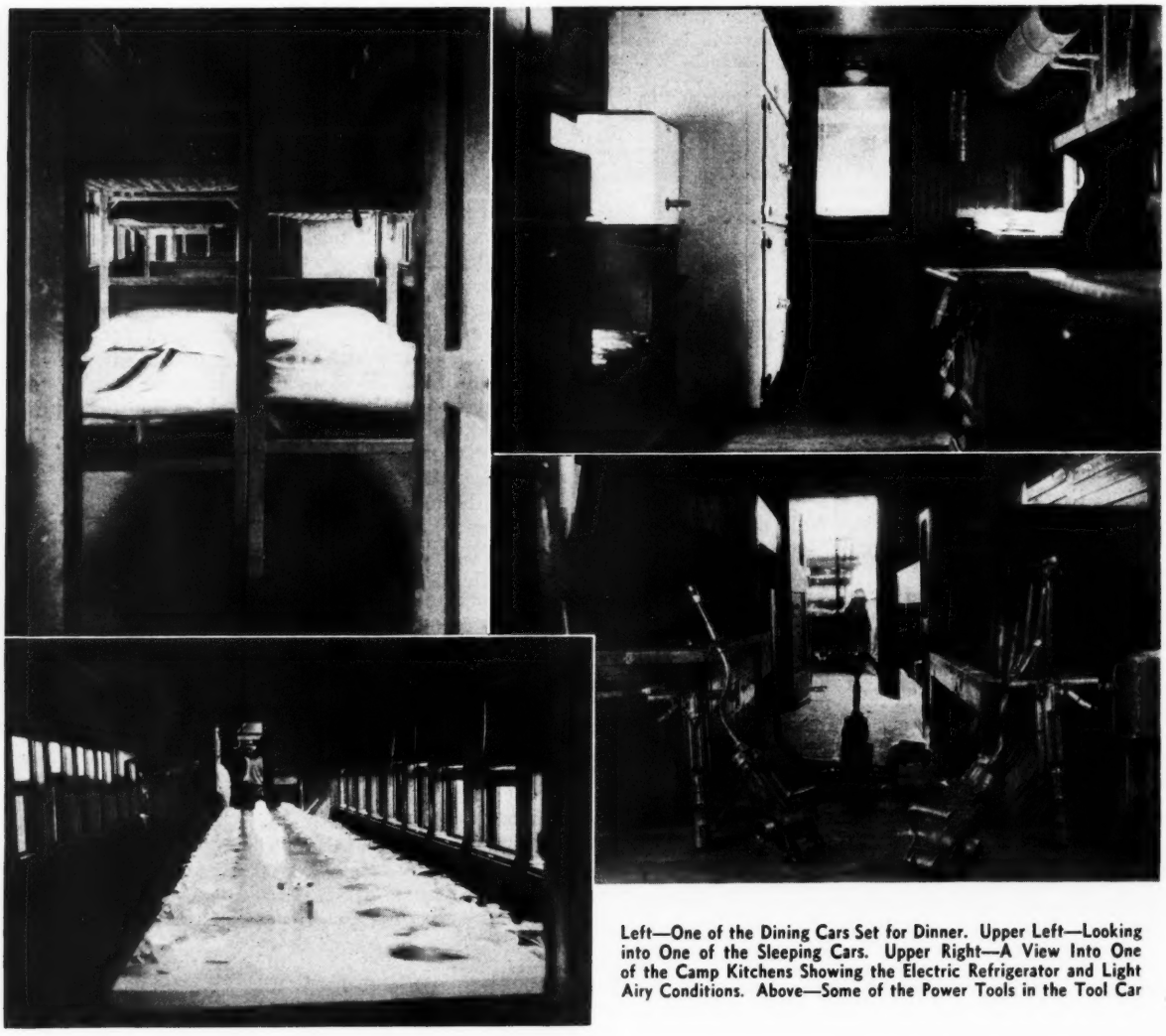
The general utility car in the train with the exception of a section approximately 13 ft. long at one end, which is fitted as a foreman's room, is given over entirely for recreation purposes. The recreation section of the car

the Pennsylvania



Left—One of the Trains at a Temporary Stand on the Eastern Region. Above—Equipment and Tool Cars of a Central Region Train on a Shady Coal Spur

is fitted with 21 double coach seats; 6 standard portable tables for use between the seats; 12 sets of table brackets; 2 library tables 24 in. by 36 in., with drawers; 2 electric ventilating fans; 2 electric exhaust fans; a linen locker with suitable shelves; a portable drinking water container of 10 gal. capacity, located in one corner of the linen locker; 2 caboose car stoves, one at each end, each equipped with a coal box; and a fire extinguisher.



Left—One of the Dining Cars Set for Dinner. Upper Left—Looking into One of the Sleeping Cars. Upper Right—A View Into One of the Camp Kitchens Showing the Electric Refrigerator and Light Airy Conditions. Above—Some of the Power Tools in the Tool Car

The foreman's room, which is fully partitioned from the recreation room, is equipped with an upper and a lower Pullman berth; a 48-in. by 30-in. flat top desk, with drawers; a desk chair; a lounging chair; an 18-in. by 36-in. clothes locker; a caboose car stove with a coal box; and an electric fan and a fire extinguisher.

Tool, Commissary and Equipment Cars

The tool car of the train is a standard box car equipped with caboose car end doors, and a suitable arrangement of hooks, shelving and bins. This car, which is designed as a storage place for all power and hand tools used by the track forces, as well as for the storage of certain supplies, is equipped with a one-ton chain hoist, which can be operated throughout the length of the car on a monorail.

There is no special significance to the commissary car ordinarily included in the train makeup, this car being a standard box car provided with suitable shelving for the storage of supplies of the commissary company in charge of the train. Likewise, there is little of special interest about the equipment car of the train, which is a flat car, except that it is provided with 12-in. side boards, has a number of eye bolts for anchoring equipment on it, and is laid with track rails throughout its length, on standard gage, to carry standard gage roadway machines. For loading and unloading these machines under their own power, the car is equipped with a pair of standard end rail skids, together with the clamps and bolts necessary for attaching the skids.

All of the cars in the train are lighted by electricity, power being furnished by a Delco gasoline engine-generator unit, which is housed on the vestibule just outside the foreman's room in the general utility car. This unit also supplies power to a floodlight which is provided with a 150-ft. extension cord and which can be attached to a bracket on the outside of the tool car or moved about the camp for illuminating night operations.

The interiors of the utility car, the sleeping cars, and the dining and kitchen cars are all painted buff with a darker dado, and all of the windows, doors and deck openings are provided with No. 16 copper wire screens. The floors in these cars are covered with linoleum

throughout, except in the toilet rooms where the flooring is of Byerlite. As a precautionary measure, suitable fenders are placed around all stoves and water heaters, and all doors, lockers and bins not intended for general use are provided with locks. The utility car is equipped with a telephone, located in the foreman's room, which can be connected to the company's telephone lines where desired. A sufficient amount of hose is carried along with the train so that the water supplies in the various cars can be replenished by direct connection with hydrants along the line.

The makeup of the different maintenance trains depends largely upon the size of the track organizations involved, but with even a relatively small organization it consists essentially of an equipment car, a tool car, one or two sleeping cars, a recreation and office car, and a dining and kitchen car. During certain of the rail laying work on the Central region in 1930, one of the trains in service, accompanying a force consisting of a general foreman, two track foremen, two assistant foremen and 51 trackmen, was made up as follows: One equipment car, a tool car, a commissary car, two sleepers, a recreation and office car, two dining and kitchen cars, and two more sleepers. The commissary work in connection with this train was handled by a cook; two flunkies, who assisted in the kitchen, washed dishes, kept the dining cars clean and served the meals; a yardman, whose duties were to keep the camp site and cars clean, and to attend to the coal and water supplies; and a clerk, or manager, representing the commissary company, in charge of the meals and supplies on the train. This group of men, all of whom were in the employ of the commissary company, with the exception of the yardman, worked as a unit entirely free from the track forces and slept in the berths provided in the dining cars. This general arrangement is followed in connection with all of the trains, which are handled by different commissary companies.

Under the immediate observation of the general foreman and foremen on the different trains, the meals served are of unusually high quality. Ordinarily, two hot meals, breakfast and dinner, are served on the trains, while a substantial lunch is usually taken out to the men on the track at noon. These meals are priced reasonably and the weekly charge to each man is deducted from his pay envelope.

Strictly Observed Camp Rules are in Force

Under the direction of the general foreman and the commissary company in charge of each train, the rules, regulations and duties set up for the trackmen and commissary employees are of a high order. These vary somewhat with the different organizations, but typical examples of the rules and regulations are given in the following:

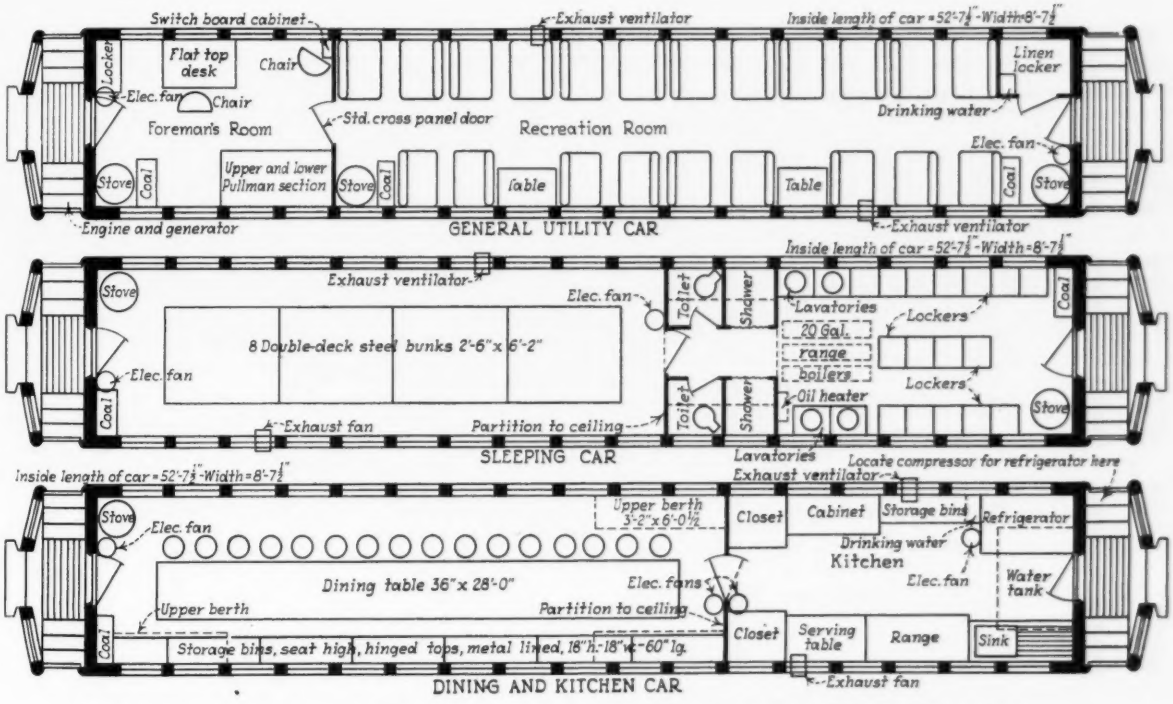
Be clean—keep the parts of the train which you use neat and orderly. Do not spit on the floor or permit cigar or cigarette stubs to lie around.

Do not keep food in the sleeping cars. Do not throw garbage or refuse of any nature about the train. It is unsanitary and invites vermin.

Do not deface the train by marks or nails. It is unsightly and destructive.

Do not tamper with the lights or power system, or with the fire extinguishers. It is dangerous.

Be thoughtful of others. The camp must be quiet by 10 p. m. If you are out after that hour, slip in quietly. Many of your fellow employees will be asleep and will not wish to be disturbed.



General Layout Plans of the Facilities Provided in the General Utility, Sleeping and Dining and Kitchen Cars

Toilets must be scrubbed and disinfected daily.

All garbage must be removed after each meal and destroyed or burned at least 50 yd. from the train.

Flies must be killed or driven out of every car, and the cars kept free from them at all times.

Bedding, including mattresses, must be sunned and aired twice each week. Linen must be changed once each week.

Beds must be disinfected thoroughly once each week, or whenever necessary to keep out bedbugs and other vermin.

Cars must be scrubbed every day.

All refuse and other matter must be kept from behind stoves and ranges.

All rubbish and litter must be picked up and removed from about the train and the site kept clean and sanitary.

Ice boxes must be scrubbed at least twice each week, using baking soda in the water to keep the boxes odorless and clean.

Dried fruits and vegetables must be kept under cover at all times.

During the summer months, tables must be kept covered with mosquito netting between meals in order that flies can not get into sugar bowls or upon clean dishes.

The clerk must inspect the cars daily and see that they are taken care of properly.

Cars and the camp site must be kept in such condition that they will be ready for inspection at any time, in order that there may be no cause for adverse criticism or complaint of sanitary conditions.

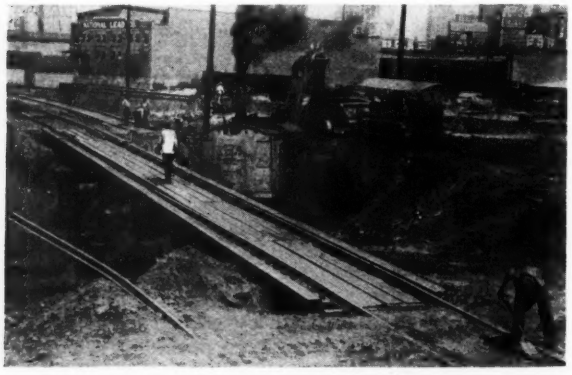
Cooks and waiters must wear clean aprons when handling food or serving meals.

While all of the trains are run on a strictly business-like basis, which involves much work and many rules and regulations, the off-time of the men is their own to do with as they please. The recreation cars are largely the center of activity at night, and here the men engage in games and have access to a large number of magazines and periodicals. Some of the trains have radios and phonographs, which have been furnished by the men to add interest and pleasure to the evening hours.

Trains Prove Advantageous

The effect of such high class trains for the housing of the men in the large maintenance gangs of the Pennsylvania has proved of distinct advantage to the railroad, entirely aside from the specific advantages which have accrued as a direct result of doing the work with large well-equipped maintenance gangs. In the first place, they have made it possible to obtain an unusually high type of personnel for the gangs. With certain of the trains, the forces are made up of picked men from the regular section forces, which were somewhat reduced in size when a large part of their work was put in the hands of the larger regional gangs.

Other important advantages offered by the trains are that they minimize the amount of unproductive time of the men in going to and from work; they form field headquarters for the foremen and for the tools and equipment; and they also provide field repair points for the track equipment, since, in practically all cases, the trains are accompanied by a special mechanic to keep the equipment in perfect running order. Furthermore, the trains, which are almost invariably in view of all main-line passenger trains, are in keeping with the standards for appearance set up and felt desirable for all other maintenance of way structures and facilities along the right-of-way.



Modern Excavating Equipment in Use on a Small Grade Separation

Rail Output Less in 1931

THE production of rails in the United States in 1931 totaled 1,157,751 gross tons, the lowest output in any year since 1896. This figure, which is taken from statistics of the American Iron & Steel Institute, compares with 1,873,233 tons in 1930 and 3,217,649 tons in 1926, the year of greatest output in the last two decades. As seen in the accompanying tables, 495,752 tons were in rails weighing 100 lb. and less than 120 lb., and 462,988 tons in rails weighing 120 lb. and over. The rails in these two groups represent 82.8 per cent of all the rails rolled in 1931, as compared with 76.2 per cent of the total in 1930. It is also significant that, whereas there was a reduction of 715,482 tons in the total production as compared with 1930, there was a decrease of only 129,945 tons in the output of rails in the heaviest group.

Production of Rails by Processes, Gross Tons, 1915-1931

Years	Open-hearth	Bessemer	Electric	Rerolled*	Total
1915	1,775,168	326,952	....	102,083	2,204,203
1916	2,269,600	440,092	....	144,826	2,854,518
1917	2,292,197	533,325	....	118,639	2,944,161
1918	1,945,443	494,193	....	101,256	2,540,892
1919	1,893,250	214,121	50	96,422	2,203,843
1920	2,334,222	142,899	297	126,698	2,604,116
1921	2,027,215	55,559	5	96,039	2,178,818
1922	2,033,000	22,317	....	116,459	2,171,776
1923	2,738,779	25,877	118	139,742	2,904,516
1924	2,307,533	16,069	....	109,730	2,433,332
1925	2,691,823	9,687	....	83,747	2,785,257
1926	3,107,992	12,533	....	97,124	3,217,649
1927	2,717,865	1,566	....	87,055	2,806,486
1928	2,580,141	2,718	438	64,196	2,647,493
1929	2,626,163	3,486	723	55,766	2,722,138
1930	1,834,933	2,137	45	36,118	1,873,233
1931	1,145,551	813	15	21,372	1,157,751

*From old steel rails.

Production of Rails by Weight Per Yard, 1917-1931

Years	Under 50 pounds	50 and less than 85	85 and less than 100	100 and less than 120	120 pounds and over	Total gross tons
1917	308,258	882,673	989,704	763,526		2,944,161
1918	395,124	665,165	888,141	592,462		2,540,892
1919	263,803	495,577	965,571	478,892		2,203,843
1920	489,043	433,333	952,622	729,118		2,604,116
1921	211,568	214,936	902,748	849,566		2,178,818
1922	265,541	274,731	728,604	902,900		2,171,776
1923	272,794	300,907	864,965	1,465,850		2,904,516
1924	191,046	213,274	853,431	1,175,581		2,433,332
1925	163,607	219,648	765,371	1,636,631		2,785,257
1926	197,260	256,287	797,662	1,966,440		3,217,649
1927	161,836	173,257	539,445	1,314,424	617,524	2,806,486
1928	134,197	125,726	465,393	1,203,749	718,428	2,647,493
1929	141,362	102,944	409,628	1,233,599	834,605	2,722,138
1930	95,626	81,299	267,879	835,496	592,933	1,873,233
1931	50,089	25,524	123,398	495,752	462,988	1,157,751

Production of Alloy-Treated Steel Rails 1921-1931

Years	Total production. Gross tons	Production by alloys		Production by processes		Production by weight per yard				
		Tita-nium	Other alloys	Open-hearth and elect	Besse-mer	Un-der 50 lbs.	50 and under 85 lbs.	85 and under 100 lbs.	100 and under 120 lbs.	120 lbs. and over
1921	6,276	2,804	3,472	6,276	....	...	71	4,277	1,928	
1922	3,163	2,493	670	3,163	....	...	321	835	2,007	
1923	2,142	346	1,796	2,142	....	...	56	317	1,769	
1924	5,167	1,696	3,471	5,167	....	...	...	847	4,320	
1925	4,009	1,616	2,393	4,009	....	70	47	....	3,892	
1926	4,216	1,099	3,117	4,216	....	...	42	1,027	3,147	
1927	1,265	....	1,265	1,265	....	...	...	374	391	500
1928	6,453	3,711	2,742	6,453	....	29	...	879	1,652	3,893
1929	1,965	486	1,479	1,965	....	100	...	748	967	150
1930	4,687	517	4,170	4,687	....	146	...	885	1,137	2,519
1931	533	....	533	518	15	...	...	282	232	19

The tables of production include also rails rerolled from defective rails and from old rails. However, this classification accounts for only 24,490 tons compared with 41,908 tons in 1930 and 156,943 tons in 1923. Bessemer rail has virtually passed out of the picture, only 813 tons having been rolled in 1931. Alloy treated steel rails accounted for only 533 tons, all of which was manganese steel rail (10 per cent or more of manganese), compared with 4,687 tons in 1930. Although 3,711 tons of titanium steel rails were rolled in 1928, no rails of that alloy were rolled in 1931.

Foundations Demand Study*

An analysis of the considerations that enter into the selection of suitable designs and the methods of procedure

By JOSEPH J. YATES

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Under-Water Pile Driver Working 20 ft. Below the Surface

OF THE elements that comprise the design of a bridge, there is none more important than the foundation, nor are there any structural features of design that have as few established rules or practices to guide the designer in his choice of type or in the establishment of safe working units for the design selected. The bearing capacities of soils, even those of similar characteristics, show a large variation, and the classification of soils is by no means an exact science. The writer, in investigating soil conditions, has found it necessary to establish certain practices as the result of an extended experience in the design of bridge foundations, which may be summarized briefly as follows:

1. A comparison of soil conditions at the proposed structure with those encountered at existing structures generally in the same vicinity. While this method will result in a safe structure, it gives no assurance that the resulting structure will be of economical design because full advantage may not have been taken of the soil bearing value.

2. An examination of the soil conditions by wash borings. Except in determining the depth to rock or to hard material, this method has little value in determining the character of the soil. Through soft material where pile foundations are required, wash borings offer an economical and generally reliable method of determining the length of piles required for the foundations.

3. An examination of the soil by core borings. Core borings are of particular value in determining the thickness of hard strata on which a foundation is to rest. It has been the practice to carry the core borings at least 10 ft. into the rock strata to determine the existence of soft seams or voids in the strata.

4. An examination of the soil by test pits. Where conditions permit, this method is the one generally used and can usually be relied upon to develop the soil characteristics.

5. An examination of the soil by means of test loads to develop their safe bearing capacity. Where reliable comparative information is not available, it is the practice to resort to this method. In designing the foundation, ½ of the ultimate test load is used, with the further provision that up to ¾ of the ultimate test load may be used for maximum toe pressures resulting from tractive force, and wind, ice and current pressures.

6. An examination of the bearing value of piles by test loads. Data so developed not only serve to determine the ultimate bearing load value of a pile but are particularly valuable in determining the horizontal resistance of the driven pile to overturning loads and, in soft soils, serve to determine the extent to which the soil support can be depended upon to develop the pile as a column. These are both factors that have often been overlooked with disastrous results.

In making pile test loads a careful record is kept in the driving of the penetration per blow of the hammer so that when the desired test load has been reached, this record may serve as a guide in driving the foundation piles to a proper resistance. In arriving at a determination of what constitutes an ultimate load, the test loads are increased until settlement occurs or until twice the unit load used in the design of the structure has been reached. In observing the test, a slight compression of ½-in. or less is not considered as settlement except in case the settlement is progressive under the load applied.

7. In tidal waters imposing conditions similar to those that obtain in New York harbor, it is the practice to keep

*Abstracted from a paper presented before the annual meeting of the American Society of Civil Engineers at New York, on January 20-23.

A Floating Caisson With a Concrete Bottom for One of the Piers of the Newark Bay Bridge, Central Railroad of New Jersey

all timber in the foundations below mean high water and preferably not above mean tide.

8. In designing foundations, the effect of the buoyancy of the water, where present, is generally not considered except when calculating the overturning resistance of the structure to horizontal forces and then only in cases where the water has access to the base of the structure, such as in sand, gravel, or porous soils.

9. In the vicinity of New York, the necessary depth of foundation below the ground surface to resist frost action is not less than 3 ft. and is generally not a limiting factor in the design, as the economical design of bridge abutments, retaining walls and column footings usually calls for a spread footing with a greater depth.

In dealing with soil bearing pressures, no method has been developed for determining the safe load that can be relied upon in all cases from an observation of the soil characteristics. The results of a questionnaire to the railroads of the country, issued several years ago by the American Railway Engineering Association, only tend to emphasize the broad limits it is necessary to assign to the soils of each class. The range is given in the following summary:

Solid rock	5 tons up
Sand and gravel	6 to 10 tons
Sand	2 to 6 tons
Clay	2 to 6 tons
Loam and clay	1 to 2 tons
Top soil, peat and marsh	Not exceeding ½ ton
Piles (timber)	10 to 22.5 tons

The determination of the resistance of soil to pressure and the action of soils under load open a large field for research and one that will result in large savings in the design of foundations.

Investigation of the Design

Foundation design is so intimately connected with the design of the structure and the method of constructing the foundation, that economy can only be secured by a correlation of the structural design, foundation design and construction method. The adoption of a reinforced concrete design offers many economies but the design is largely dependent on the foundation conditions and methods of construction. A fully reinforced concrete retaining wall is often the economic solution but it may be found that when the three factors are considered, a semi-reinforced wall would be the most economical, although it may have a greater volume of concrete.

The generally accepted methods of calculation of the lines of pressure in the foundation of a structure that have been established through long practice are adequate in the opinion of the writer and will result in an economical design, provided the designer has correctly interpreted the soil conditions.

Where the foundation is to rest on soil, the spread footing is a necessity and will result in a well balanced structure. It permits the full use of the reinforced abutment and retaining wall design and often results in large savings.

Where water with a head of several feet is encountered in the foundation excavation it has been the practice to require the excavation to be made or the cofferdam, if used, to be constructed larger than the dimensions of the foundations so that the water may flow freely to the pump sump through channels outside of the limits of the foundation. Under such conditions the construction of the cofferdam of the same dimensions as the foundations and the depositing of the foundation concrete against the cofferdam often result in disaster or at best in a poor foundation, due to the disturbance of the freshly deposited concrete by the head of water created under the foundation course.

Many of the above observations in regard to foundations in soil are applicable to foundations in water, and as their application is evident it will not be necessary to repeat. The writer wishes, however, to emphasize the necessity of determining the method of constructing the foundation in connection with the design of the structure.

Pile Foundations

Piles offer an economical method of creating a foundation in compressible soils. Their safe bearing value is seldom utilized and engineers are prone to assign low values rather than go to the expense of making tests. On small structures this course is no doubt justified, but on costly structures an investigation of the bearing value and the resistance to horizontal loads is desirable and will generally result in large savings. It is evident that a pile driven through hard material to a refusal that will not result in damage to the pile is safe for a much greater load than a pile driven to the same refusal through a soft strata, due to the greater development of the pile as a column by the harder material.

It has been the writer's practice to carry the foundation concrete to a point one foot below the cut-off of the piles to assure that the piles act as a unit in resisting horizontal loads. Where pile foundations are in shallow water, the structure may be constructed economically by means of open cofferdams, but where a greater depth of water is encountered, it is usually more economical to sink floating caissons on piles which have previously been cut off to the proper level. In water depths of even as little as 10 ft. a substantial saving can often be made by driving the pile head under water to the approximate cut-off, either by means of a follower or by the use of the underwater hammer. The piles can then be cut to the desired level by a saw mounted on a vertical shaft and operated from a floating barge or fixed platform.

Experience has developed that the spacing of foundation piles should not be less than 30 in., center to center, in order to permit proper driving. A short pile is of little value unless driven through reasonably hard material to rock or hard pan, and the writer has adopted the specification requirement that foundation piles must have a length of at least 15 ft. in the work, and has often found it necessary to require the jetting of piles to obtain the minimum requirements.

Floating caissons are generally constructed with either a timber or a concrete bottom, with detachable wood sides which may be removed after the caisson has been settled on the piles and the pier construction has been carried to a point above high water. The writer has obtained a decided saving by using a caisson with a concrete bottom, where this proved practicable in construction requiring a number of piers of the same design. In the case of wood-bottom caissons, the governing pile load is determined by the low allowable stress across the grain of the timber bottom of the caisson, while with the concrete bottom the much greater strength of wood with the grain is the limiting factor, thus permitting a higher pile bearing load in cases where soil and driving conditions are favorable.

The advantages of the wood-bottom caisson lie in its lower cost of construction and the fact that concrete-bottom caissons must be constructed on shipways and launched while the wood-bottom caisson may be constructed floating. Wood-bottom caissons are economical in structures where only a few piers are required, and where the cost of shipways would more than offset the lesser cost of the concrete bottoms.

This Trestle on the Santa Fe Has Seen 33 Years' Service

After Fifty-Seven Years*

By R. A. VAN NESS
Bridge Engineer System,
Atchison, Topeka & Santa Fe

In this article Mr. Van Ness outlines the history of timber preservation on the Santa Fe from its inception in 1875, when a plant was constructed at Galveston. He discusses the various problems that have been encountered during this time and reviews the most recent practices on his road.

THE history of treated timber on the Santa Fe began in 1875, when a plant was built in Galveston for the creosoting of piles for the timber trestle bridge in Galveston bay. This piling was supposed to be given a 10-lb. treatment, but some of the piles were treated to refusal. The lighter treated piles stood up well for 10 or 12 years; and the heavier treated piles until the end of 20 years.

It was not until 1885 that the Santa Fe built its own plant. This was at Las Vegas, N. M., and was used for tie treatment between 1885 and 1908 inclusive, for lumber treatment from 1895 to 1907 inclusive, and piling treatment from 1895 to 1906 inclusive. In 1897 the Ayer & Lord Tie Company built a treating plant at Somerville, Tex., to treat ties, lumber and piling under contract for the Santa Fe. The Santa Fe took over this plant in 1904, and in 1906 built a new plant at this point. In 1898 the Santa Fe opened a plant at Bellemont, Ariz., which burned in 1906. In 1908 the Las Vegas plant burned, and a plant was built at Albuquerque in that year to take the place of the Las Vegas and Bellemont plants. In 1924 a plant was placed in operation at National City, Cal. In 1930 a plant was placed in operation at Wellington, Kan. Thus, the Santa Fe now has plants at Somerville, Albuquerque, National City and Wellington.

Records indicate that the two oldest creosote-treated timber bridges still in service on the Santa Fe were constructed in 1899 on the main line in Missouri, and are of the ballast deck type. The deck timbers are 12-in. by 12-in. in section, and inspection indicates that these deck timbers have 10 or 15 years life remaining. There have been renewals, particularly of sway braces, but these bridges can be considered good for at least forty years' service.

The extent to which treated timbers have been used in Santa Fe bridges, can be seen from the data listed below. T-rail bridges are classed as steel bridges. Concrete arches and boxes, timber boxes and culvert pipe are omitted, although attention is called to the fact that by far the larger proportion of the timber boxes are creosoted.

Type of Bridge	As of January 1, 1931 In lineal feet of single track
Open deck timber bridges	477,004
Ballast deck timber bridges	287,321
Open deck steel bridges	83,818
Ballast deck steel bridges	223,430
Reinforced concrete slab bridges	8,844

Thus, as of January 1, 1931, the total length of single-track bridges resting on timber and concrete pile bents, masonry piers and abutments, was 204.62 miles. Of this length some 48 per cent is of ballast deck construction in which treated timber only has been used. Records are not available on which to base definite statements regarding the extent to which treated timber is used in the open-deck timber bridges, but it can be stated that approximately 90 per cent of the pile bents are treated, and that within 20 years practically 100 per cent

*Abstracted from a paper presented before the annual meeting of the American Wood-Preservers' Association, at St. Louis, Mo., on January 27.

will be treated. The stringers of open-deck timber bridges were untreated until some five years ago, and up to that time it was the policy to replace untreated bridge ties with untreated material. Now that treated stringers are being used, all of the new open-deck bridges will have treated ties. Practically all ties are treated for open-deck steel bridges. The above data indicate that the Santa Fe is approaching 100 per cent treatment of timber bridges and that this status probably will be reached within the next 25 years, except for a small number of open-deck timber bridges on light-traffic lines in those climates where the present untreated timber bridges will still last for many years.

From 1885 to 1931 the Santa Fe treated about 300,-134,000 ft. b.m. of timber, and about 90 per cent of this amount was bridge timber. During the years noted, some 14,700,000 lin. ft. of piling was treated, and practically all of this piling was used in the construction and repair of timber trestle bridges.

Type of Treatment

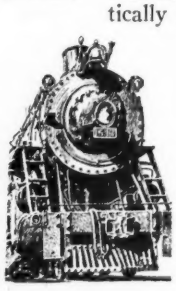
When the Santa Fe first began to use creosoted bridge timber it was obtained mostly from commercial concerns, and as the timber usually was ordered for quick shipment, sufficient time was not available for air-seasoning. It is now the practice to stock our plants sufficiently in advance of our needs to permit time for thorough air-seasoning.

Bridge timber and piling have been treated on the Santa Fe with creosote from the first, with various retentions of creosote for fresh and salt-water structures. We are now treating bridge ties with an 8-lb. mixture by the Rueping process. At present we are getting 14-lb. per cu. ft. of creosote into southern pine bridge timbers, and are treating Douglas fir to refusal. We are considering the adoption of treatment with a mixture of creosote and petroleum, of which we will put a maximum of 16-lb. per cu. ft. into southern pine bridge timbers and by incising the fir bridge timbers, we will get 13 lb. per cu. ft. of the mixture into the fir. We are now incising our Douglas fir timber and getting a 13-lb. creosote treatment. Southern pine piling is now receiving a 16-lb. full-cell treatment with creosote, and Douglas fir piling is being treated to refusal with about 13 lb. per cu. ft. We are considering the adoption of a mixture treatment for all piling and will treat them to refusal, but not to exceed 18 lb. per cu. ft. We are treating a small amount of red spruce piling.

The creosote being used varies but slightly from that specified as Grade 1, A.R.E.A. specifications, 1929 Manual. The oil in the bridge-tie mixture used at the National City and Albuquerque plants is of asphaltic base, from Seguro, Cal. The Somerville and Wellington plants are supplied with a residue oil from Ardmore, Okla., and Ponca City, respectively.

The mixture treatment of our bridge ties calls for a 50-50 mixture of creosote and petroleum. This will be used also for bridge timbers and piling if a mixture treatment is adopted.

It is considered entirely safe to adopt a creosote-petroleum mixture treatment for bridge timbers and piling since there will be sufficient toxicity to inhibit the growth of rot-producing fungi, and the viscous oil tends to retard the evaporation of creosote. Therefore, it is felt that at the end of a number of years it is quite likely that there will be as much creosote remaining in the mixture-treated timber as there would be if straight treatment were used and evaporation proceeded at a faster rate. Most important of all, it is believed that the mixture treatment will greatly lessen the season-checking of the timber, particularly in the dry, hot climate that is encountered along our lines in certain portions of Arizona and California.



Effect of Incising on Strength

I mentioned previously that by incising Douglas fir bridge timber, we are getting a retention of about 13 lb. per cu. ft. of preservative. Some months ago, E. E. Chapman, our engineer of tests, completed a series of tests to determine, as nearly as possible, the weakening effects of incising on fir bridge stringers. Test results on incised untreated and treated, and non-incised treated fir stringers, indicated that the incised treated stringer lost an average of only eight per cent in strength due to the incising. We do not object to this loss in strength in treated incised fir stringers because we believe that these stringers will, at the end of 40 years' service, be in better condition, with greater remaining strength than would be the case with similarly treated non-incised stringers having four or five pounds less initial preservative. Another vital factor which makes an incised fir stick desirable over a non-incised stick, is that the incised stick requires only 15 hours to treat as against 24 hours for the non-incised stick, and of course the shorter time of treatment makes for a product having a minimum amount of treatment checking.

Creosoted timber bridges had not been in service many years on the Santa Fe before it was discovered that simply treating the timber was only half the battle in getting timber bridges that gave satisfactory service. It was found that it was poor policy to allow piling to be kept in the woods after cutting, but that they should be sent at once to the treating plant, supported on steel, concrete or treated timber skids, and allowed to season properly before treating.

Years ago, driven piles were cut off and the tops chamfered before the caps were drifted on. Because of this practice, thousands of piling decayed at the top after a few years' service. The chamfering of piles, after cutting off was discontinued, and before the caps were placed the cut surface of the piles was sealed with creosote and heavy oil, and the top covered with two-ply roofing paper, nailed down on the sides of the pile. Also, it was discovered that field holes in timber were causing rot, and thus the practice was adopted of swabbing field holes with hot creosote and a sealing compound, and also of treating any cut surfaces similarly.

Care of Piles When Driving

It was discovered in the early days that in driving piling the heart would sometimes be separated from the sapwood. After various improvements in practice most of our pile driving is now done by double-acting steam hammers with a steel cap over the head of the pile to restrain the timber, with the result that we have practically no piling damaged in driving. The practice of preboring timber before treatment is increasing rapidly and, in addition, the timbers are being preframed before treatment. Our experience, and that of other organizations using treated timber for bridge structures, convinces us that bridge timbers can be bored and framed successfully before treatment, and we are preparing standard plans for open deck and ballast deck timber bridges, and timber boxes, on the basis of boring and framing the timber before treatment.

The following rules have been adopted tentatively relative to the handling on the Santa Fe of treated timber and piling for permanent timber bridges.

1. All timber and piles shall have a preservative treatment.
2. Before treatment is applied, all timber shall be cut to exact lengths, surfaced and prebored, as may be required by the plans.
3. To justify the construction of permanent timber bridges, a long life must be obtained and maintenance costs must be slight; consequently, extreme care should be exercised in the handling and placing of treated timber and piles.
4. Damaging of the surface of treated timber or piles by the unnecessary use of timber hooks, peevies, etc., should be avoided. When possible, treated timber and piling should be handled by rope slings, and should be handled to final position and not allowed to fall.
5. When it becomes necessary to work from scaffolding in constructing the bridge, such scaffolding should be supported, when practical, in some manner other than by nailing it to the treated timber and piling.
6. When necessary to disturb the surface of treated timber or piles, or when the surface has been damaged through handling, such surfaces must be mopped with a liberal quantity of hot preservative, followed by two applications of hot sealing compound (20 per cent creosote and 80 per cent coal tar pitch).
7. When necessary to bore holes in treated timber or piling in the field, such holes shall be well swabbed with hot preservative or be treated by the hot preservative forced into the hole under pressure, and the holes then swabbed with hot sealing compound before bolts are inserted. All bolts are to be cleaned of rust and scale and dipped in hot sealing compound before being inserted. All unused holes, either pre-bored or bored in the field, are to have the ends fitted with round treated wooden plugs, dipped in hot sealing compound before being driven.
8. The tops of piling under caps are to be treated with hot preservative, followed by two coats of hot sealing compound, and then covered with a sheet of two-ply roofing paper of the best grade.
9. Preservative and sealing compound can be obtained from the system treating plants, and will be supplied upon regular requisition on the store department.
10. Before driving drift bolts connecting the stringers to the caps in ballast deck timber bridges, the stringers are to be pulled together, but in so doing, care must be exercised so as not to bruise or otherwise damage the treated timber.

Attention is directed to the fact that while the above rules would seem to pertain mainly to timber pile trestle bridges, such rules, so far as applicable, will apply to treated timber used in permanent timber highway bridges, timber boxes, and for timber used for ties and deck timbers on steel railway and highway bridges.

Rules for Fire Prevention

[Fire prevention is among the many duties which fall on the shoulders of the maintenance officer. What these duties embrace is set forth in the following rules which were prepared by the Committee on Rules and Organization of the A. R. E. A. and were presented as information at the convention in Chicago on March 15, with a view to their later adoption as standard practice. —Editor.]

ALL duties pertaining to fire prevention measures and fire protection equipment shall be exercised by the officers named herein, under full co-operation with the superintendent of fire prevention, local chiefs of fire brigades and with such other officers as may be specifically responsible for fire-prevention matters.

Division Engineers—They are responsible for fire-prevention conditions on their respective divisions. They will see that terminals are laid out and buildings designed with proper attention to fire prevention. They must know that their supervisors are properly instructed in fire-prevention rules, alert in decreasing fire hazards and exacting in the maintenance and operation of fire-fighting apparatus.

Supervisors of Track—They must give particular attention to fire hazards from adjoining property and from structures erected on railway property by lessees. They must see that those under their supervision do not obstruct fire roads, fire hydrants and hose houses. They must see that no lumber, ties, piling or other inflammable materials are piled within 50 ft. of any important building and that automobiles or trucks are not parked in a manner which constitutes a fire hazard. They must know that all their foremen understand and rigidly observe all fire-prevention rules.

Supervisors of Bridges and Buildings—They must give particular attention to fire hazards where the risk is extreme, as at oil houses, paint shops, wood coal chutes, cotton platforms, etc. Plans must be made to confine any fire in the place of origin. They must make proper reports to supervisors so that no unguarded fire hazards are allowed to develop due to the manner of operation of any shop or office. They must see that those under their supervision do not obstruct fire escapes and exit passages thereto, fire doors, hose reels, fire hydrants, fire roads, and hose houses. They must see that all those under their supervision are familiar with the location and use of the nearest fire alarms on the property.

They must see that all sprinkler systems are maintained in positive working condition and that all fire-fighting apparatus is in good working order and ready for instant use by assigned employees. They must arrange for the proper co-operation of all municipal fire departments. They must make recommendations for necessary fire walls, doors, shutters, etc., and for the removal of any fire hazards. They must know that all their foremen understand and rigidly observe all fire-prevention rules.

Supervisors of Water Service—They must know that fire pumps and fire lines are in good working condition and able to deliver sufficient volume of water to quench any fire on the property. They must see that fire hydrants and hose are always ready for instant use. They must see that, where possible, proper connections are made to all municipal fire mains. They must know that all their foreman understand and rigidly observe all fire-prevention rules.

Supervisors of Telegraph and Telephones—They are responsible for the proper installation and maintenance of all electrical fire-alarm systems and must see that all fire alarms are in working order. They must see that the proper connections are made to all municipal fire-alarm systems. They must see that all wires are properly installed and equipped with approved protective devices.

Raising Track on New Ballast, C. M. St. P. & P.

Machine Methods Employed in Cleaning Ballast*

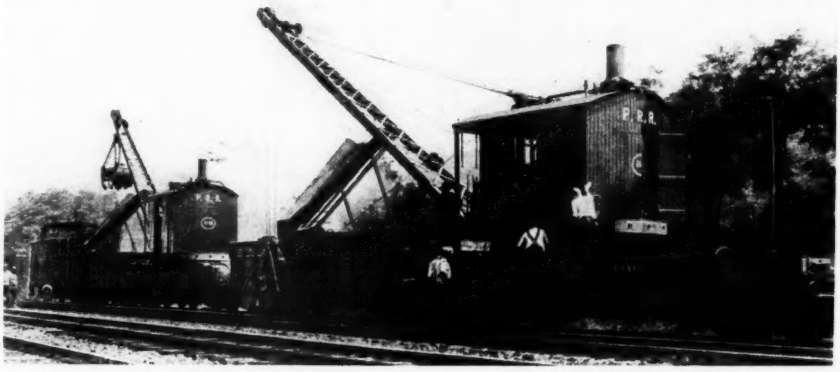
A. R. E. A. committee reports on types of equipment which have been used, cost of doing the work and the organization required with each

THE earliest method of cleaning ballast was by means of the ballast fork operated by hand, but this was tedious and costly, and the cleaning was rarely carried deep enough below the bottom of the tie to be really effective. In 1911, the first experiment was made with means for cleaning ballast mechanically, and in 1919 a machine was brought out which operated in the center ditch and did not obstruct the adjoining tracks. The Pratt patent covering this method of working is one of the few fundamental or basic patents which have been obtained in recent years. This machine was too flimsy, however, and it failed frequently on account of breaking of parts, so that its development was abandoned.

A little later, one of the eastern railroads experimented with ditchers, using a clamshell bucket to lift the dirty ballast from the center ditch and pour it over a screen set at an angle of 45 deg. on top of a gondola car, the dirt falling through the screen into the car and the cleaned stone running over the side of the car back into the track. This was the first successful method of cleaning ballast mechanically and soon became quite common. By working with several units in a train and using gasoline instead of steam cranes, it is still one of the cheapest methods of cleaning ballast.

With this method, the total cost, including interest at 6 per cent, depreciation 10 per cent, annual overhaul 10 per cent, operating expenses, wages, fuel and supplies, etc., is from 8 to 11 cents per lin. ft. of center ditch cleaned. The depth cleaned is usually from 12 to 16 in. below the bottom of the ties, and the variations in cost are due primarily to interruptions caused by traffic on the adjoining tracks, length of run from the layover point, etc.

In the meantime, other experiments were undertaken and various schemes were tried. Revolving and shaking screens fed by hand-shoveling were used, and the vacuum and revolving brush sweepers were built. A very large vacuum machine was tried in 1925 but found unsatisfactory; in 1926 the "mole" type was brought out. A considerable number of these machines are in use by various railways, mostly in the East, and they have the advantage of doing their work without obstructing a track. In multiple track territory, conveyors can be used to carry the dirt across one track, and border moles are now available for cleaning the shoulder.



One of the Earlier Methods of Cleaning Ballast Mechanically

A Ballast Cleaning Machine of the Scoop Plow Type

The total cost of operating moles in the center ditch, with all items of expense included, varies from 8 to 12 cents per lin. ft., and the average production is about 15 miles per season. They usually clean from 8 in. to 10 in. below the bottom of the ties. On busy railroads considerable interruption is caused by passing trains, but the machines do not interfere with traffic, and are preferred on many roads for this reason. Border moles operate at a cost of 3 to 6 cents per lin. ft.

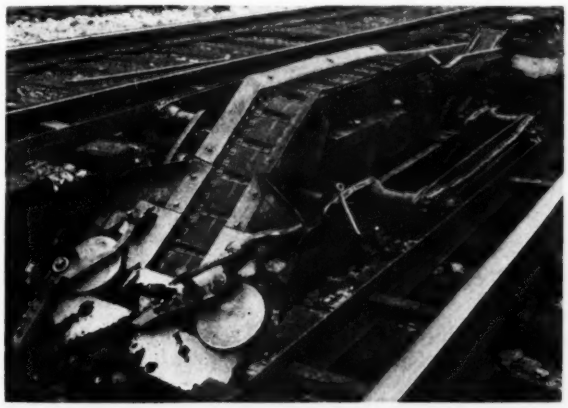
*Abstracted from the report of the Committee on Maintenance of Way Work Equipment, presented at the American Railway Engineering Association convention at Chicago on March 15. The chairman of the subcommittee assigned to this subject was William Elmer, special engineer, Pennsylvania.

In 1927, a large special machine was built for one of the eastern roads, which has proved satisfactory. It consists of two steel under-frame cars, the front one provided with two clamshell buckets operating in curved guides, both on the same side of the car and spaced about 15 ft. apart. The buckets open 8 ft. and the car is moved forward about 6½ ft. at a time. The outfit is provided with two power plants, one having a 250-hp. gasoline engine which drives a 250-volt generator and the other an auxiliary of smaller size for furnishing current during the 8-hr. layoff trick when the overhauling is done. All functions are motor driven, each of the buckets being controlled by an operator, while the train is moved forward about 6½ ft. at a time by an electric winch, which requires another operator. The locomotive which takes the train from the layover point to the place where the work is to start cuts loose from the front car and a sheave block is attached to the coupler. The locomotive then moves several hundred feet away from the train, unwinding the wire rope from the haulage drum. Brakes are then applied and the engine serves as a "dead man" until the train has moved up to it.

The dirty ballast which is dug out of the center ditch by the clamshell buckets, is raised and poured into hoppers near the center line of the car. A conveyor passes under these two hoppers and transports the material to the rear, elevating and discharging it into a chute which spans the gap between the two cars. At the front end of the second car there is a vibrating screen of ¼-in. wire with the meshes having a 1-in. clear opening. As the dirt falls through, it is conveyed to the rear and elevated to a chute spanning the gap to the following car. The clean stone is delivered to a chute which feeds it from the side of the car back into the center where it is shaped by a scraper into the contour desired. Seven standard four-hopper coal cars of 140,000 lb. capacity are usually carried in the train for receiving the dirt. Each is equipped with a motor-driven scraper conveyor running lengthwise over the top of the car and there are openings in the bottom of the conveyor with gates which permit loading the car at several points. The conveyors are removed from the loaded cars to a string of empties at the layover point, by means of a crane built onto the outfit for this purpose.

It is customary to work this machine for 16 hr., changing crews in the middle of the period and then running to the layover point for changing conveyors, shifting out the loads, receiving fresh supplies of gasoline and oil, making minor repairs, giving lubrication the necessary attention, etc. Unless the ballast is too wet, the usual speed of operation is three grabs a minute, moving forward about 20 ft., or from 1,000 to 1,200 ft. per hr. if there are no interruptions. Cables sometimes break, however, and various minor repairs are needed on the job, so that this speed of advance cannot be counted on continuously. Furthermore, when trains are passing on the adjoining track on the side where the buckets are operating, the work must cease. The maximum production so far obtained is 256,000 lin. ft., or about 48 miles, of cleaned center ditch in a month, working two tricks per day and six days a week.

The machine costs $150,000 complete, and with interest at 6 per cent, depreciation at 12 per cent (which is the weighted average) and annual overhaul at 10 per cent, the total cost including operating expense, train and engine crew wages and expenses, locomotive rental, fuel and supplies, etc., is about 6¼ cents per lin. ft. The working season is eight months. The first machine built has been operated on a rental basis and two more recent machines are owned by an eastern road.



Upper Picture Shows Front View of the Center-Ditch Mole

A General View of the Large Ballast-Cleaning Train Used on Eastern Railways

Further Development in 1930

In 1930, another design of ballast-cleaning machine was tried out on one of the eastern roads, and during 1931 it cleaned about 200 miles of center ditch on another road. This machine is mounted on a special steel-frame flat car followed by an idler and is pulled by a gas-electric or steam locomotive. It operates at a speed of about 60 ft. per min. and is a double-sided outfit, i. e., it can clean simultaneously on both sides of the track on which it is moving. With the present machine a minimum spacing of 12 ft. 9 in. center to center of tracks is required in order that the machine may be continued in cleaning operations without interfering with traffic on the adjacent track.

The ballast is lifted by a scoop or flat-nosed plow, which is essentially a box about 24 in. wide with two sides and an inclined bottom without top or ends. This can be lowered down over the side of the car and set at any desired depth down to 29 in. below the top of rail, but is usually operated 8 in. or 10 in. below the bottom of

the ties. As the car moves forward the ballast is crowded up the slope of the box and falls over the end on to a short inclined belt conveyor, over the upper end of which it falls to a long belt conveyor which rises toward the rear of the car and pours the dirty ballast over a vibrating screen. The cleaned ballast can be delivered between the rails or back into the center ditch. The dirt is delivered to an 18-in. belt conveyor supported by a 23-ft. boom, which is pivoted under the dirt hopper and can be swung out on either side of the car. On a three-track railroad, when the machine is operating on the middle track, the dirt is delivered beyond the outside shoulder of the adjoining track.

Following the front scoop, which must be set far enough out to miss the long ties, there is a plow, which rides against the ends of the ties under spring pressure. This plow removes whatever material is left immediately along the ends of the ties and delivers it across the ditch formed by the front plow to the center line of the intertrack space. The cleaned stone can then be deposited in this excavation. When the machine is placed on the adjoining track for another run, some dirty ballast is crowded over on to the portion already cleaned, so a third trip is run over the track first operated on in order to get out all the dirt. In case of very dirty ballast, a fourth and sometimes a fifth trip is run, if necessary.

The operating crews consist of three men, the power plant being a 30-hp. gasoline engine, and all functions of raising and lowering the scoops and plows and retracting the lower ends of the conveyor toward the center line of the car are controlled by friction clutches and levers grouped in a cab at the front end of the car. The machine has been operated on a rental basis at a cost of 5 cents per lin. ft. of center ditch cleaned, and the railroad expense for engine and train crew wages, locomotive, etc., is 1½ cents per ft., making a total cost of 6½ cents per ft.

Previous to the advent of the border mole a good deal of work had been done on discers, plows and scarifiers. A machine of this type will do about 125 miles of border in a season, at a total cost of $7 a mile.

No machine has yet been perfected for cleaning the cribs. A skeletonizer was brought out a few years ago which worked fairly well in gravel ballast but failed in stone, and the costs of operation and maintenance were unduly high.

Organizations Needed

[Accompanying the report was a table showing the organization required with each of the types of machines mentioned. An abstract of this information follows.—Editor.]

A single mole equipped with a dirt conveyor requires 1 machine operator, 1 flagman, 2 laborers moving racks ahead, adzing ties, etc., and 1 laborer leveling down the dirt. Two moles, each equipped with conveyors, working together, require 1 foreman, 2 machine operators, 1 flagman, 4 men moving racks ahead and 2 men leveling down the dirt. If the moles are not equipped with conveyors, from 2 to 4 additional men will be required with each machine to carry and dispose of the dirt removed from the ballast. Border moles require 1 machine operator and 2 men to handle the racks, level the dirt, etc.

Locomotive cranes should be worked in groups of four or five. For each group, a locomotive and train crew and a foreman will be required. If the cranes are steam-operated, it will be necessary to have a crane operator and fireman with each machine. If powered with a gasoline or Diesel engine only the crane operators will be needed. Two laborers are necessary with each crane.

With the special machine which was first used in 1927, train and locomotive crews are needed with each shift, while the operating crew consists of 1 general foreman who covers both shifts, and for each shift 1 foreman, 3 operators, 1 mechanic, 1 helper and 1 laborer. In addition, 1 mechanic and 1 laborer overhaul the machine, attend to lubrication and provide fuel, oil and other supplies during the third or idle period.

The machine which was put in service in 1930 requires a train and a locomotive crew, 1 foreman, 1 operator and 2 laborers.

A Safety Message to the Section Foreman*

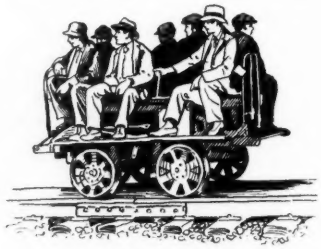
WHILE the section gang is unquestionably the foundation of safety in railroad transportation, the firmness of that foundation is established solely by the frame of mind of those who direct its building. This applies not only to the building and maintaining of safe track, but to the degree to which the section foreman recognizes and discharges his responsibility for building and maintaining safe men. The section foreman who builds a safe gang and maintains the principle of safety

Men and Tools Unsafely Loaded—No Lookout Behind

throughout the performance of every duty will certainly build a reputation for producing both safe men and safe track.

Of course, no section foreman can always watch the individual performance of his men; therefore, he must establish in the mind of each member of his force the firm conviction that safety is to him a personal matter.

A study of accidents to maintenance of way and structures employees for 1930 indicates that of a total of 257 deaths among employees, 14 were caused by collisions of hand and motor cars with trains and 44 deaths were occasioned by hand and motor cars meeting with accidents not involving the movement of trains. Thus we see that



Men and Tools Safely Loaded—Lookout in Both Directions

23 per cent of the fatalities among maintenance of way and structures employees were caused by the use of hand and motor cars.

The motor car is indispensable and in daily use, and must, therefore, be subject to rules and regulations as to its operation. Not only should rules and regulations

* From Circular No. 320 issued by the Committee on Education, Safety Section, American Railway Association.

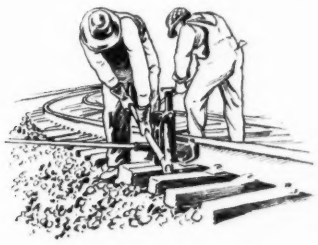
govern the movement of cars against trains, but, because 14 employees were killed in collisions of cars with trains and 44 were killed in motor and hand car accidents in which trains were not involved, such as collisions between such cars and derailments of this equipment, it follows that this movement needs regulation to prevent accidents.

This also applies to inspection and implies that no hand or motor car should be placed on the track for service until the foreman has first carefully inspected, not only the car itself, but the tools placed on the car to see that all are safely loaded. There is no one who can do this for the foreman. He must do it himself.

When Trains Are Passing, Clear All Running Tracks Unless Otherwise Protected

The placing of men on the car is another important responsibility of the foreman to insure that a lookout is maintained in both directions, and that each man has a place on the car and occupies that place. The conduct of the men while on the car should be carefully watched and no playing or scuffling permitted. A requirement rapidly coming into vogue is that every motor car driver shall be examined on the operating rules and the rules for the movement of motor cars and shall always have a certificate as to his fitness on his person when on duty.

A large percentage of non-fatal injuries to employees in track service is occasioned by haphazard methods of placing cars on and removing them from the tracks. Here, again, of paramount importance is the principle, "Every man to his place." Let that place be well defined and give particular attention to the placing of feet on the ground and the manner of lifting.

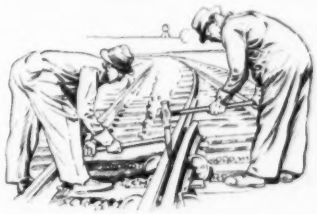


Remove Jack Handle When Not Needed

A comparison of 1930 with 1923 on the basis of the number of man-hours worked per accident shows that there was a reduction of 37 per cent in the number of deaths and 58 per cent in the number of injuries among persons employed in the maintenance of way and structures. The greatest progress in reducing fatalities in this class was in train-service accidents. In this class there were 207 fewer deaths, a reduction of almost 60 per cent. A natural assumption is that this remarkable reduction is a result of fewer men being struck or run over by trains. A remedy probably contributing to this fine showing is the rigid requirement which has been adopted by some railroads that, while a train is passing on a running track, employees must clear all running tracks unless otherwise protected. Space does not permit a discussion here of the numerous hazards met by track forces in the performance of their duties. An attempt has been made to cover only the most pronounced.

The application of psychology has had much to do with reducing accidents and injuries among maintenance of way and structures employees, who usually try to carry out the wishes of their managers. Various railroads have adopted different means of producing good safety records through psychological endeavor. Some have adopted a metal plate reading "No Accidents This Year" which the section foreman is permitted to display prominently over the door of his toolhouse on the first day of January and thereafter unless he has a reportable accident, when he must remove the sign and send it in to his superior. Some railroads furnish a metal tag to be attached to the motor car and handled in a like manner. The psychology in each case is that the foreman and his men are proud to display the sign where even the president may see it, and will put up a good safety fight to avoid sending in his badge of honor with the acknowledgment that he has failed.

Many railroads furnish each year to the foremen with clear records a special merit card which they are proud to carry on their persons. These cards commend the foreman for good safety supervision, and each succeeding year with a clear record brings a card signed by an officer of higher rank. This has proved effective.



Safe Method of Spiking Between Running and Guard Rail—Track Punch On Spike, Sledge Used Instead of Spike Maul—Both Wearing Goggles

Short safety meetings of foremen with their men at regular intervals are valuable. Strict enforcement of safety rules not only prevents accidents due to violation of those rules, but creates a state of mind that regulates the acts of men, even though no rule is involved. With these few suggestions, naturally brief and incomplete, this matter is now placed in the hands of the section foreman who is qualified and expected to build and maintain safe men and safe track.

A Safety Pledge*

I Pledge Myself:

To think always of my own safety and the safety of my fellow men.

To keep my eyes open for unsafe conditions and to take proper measures for their remedy.

To keep the machinery I work with and tools I work with in good order.

To wear goggles whenever there is a chance of an eye injury.

To attend at once to the most trivial injuries that I may sustain.

To be helpful to my fellow men, especially to the new man.

To be orderly in my habits.

To keep my temper.

To make allowance for the other man's weakness.

To consider the day lost in which I failed to improve myself, or my home, or my work.

To be cheerful, hopeful, useful, careful.

*By the Bureau of Mines, University of Arizona.

Getting Along on the Job*

Some pertinent remarks on how to advance in railway work, with particular reference to making the most of a promotion

By ARMSTRONG CHINN
Chief Engineer, Alton, Chicago

EVERY normal man with ambition is buoyed up and sustained in his work, in part at least, by the ever-present hope that he is working and progressing toward something better, and it is that hope that often carries him through rough going that would otherwise retard if not halt his progress. Work on a railroad may be divided into three phases—promotion to the job, successfully holding the job, and preparation for the next better job.

Every one who progresses does so by stepping up to a job of greater responsibility. When this step is finally made, the fortunate individual is placed in a new field of work with which he is not entirely familiar. Naturally he is desirous of making a favorable impression at once to justify his superior officer's judgment in selecting him for promotion, but is often handicapped by lack of familiarity with his new work and an accurate knowledge of just what his superior expects him to do. A man on a job that is new to him is always moving on dangerous ground. Because he is new to the job, every move that he makes is being watched by both superiors and subordinates, and his character and ability are going through a period of critical analysis. If he can keep his feet on the ground and weather this period successfully his future on the job is assured.

The First Thing To Do

When a man is promoted to a new job, the first thing for him to do is to find out in as much detail as he can exactly what his boss wants him to do, how he wants it done, when he likes to have it done, and to what extent he is expected to exercise authority. It is well for him to recognize that he is working for an individual as well as a company and is, in the nature of things, a representative of that officer who is expected to carry on his work in the same manner that the superior would himself conduct it. The average officer, while keeping his mind open to ideas and suggestions, has little patience with a subordinate who is not inclined to be governed by established policies. He feels that in accepting promotion, a man acknowledges his willingness to follow his superior's methods as nearly as possible.

For these reasons I am convinced that a man in a new job should find out, first of all, what his boss wants. Being a busy individual himself, the boss is likely to say, "Well, here's your job, go to it," and the man on the new job is left to muddle along as best he can, hoping but seldom knowing whether his actions are in accordance with his boss' wishes, unless he has the situation well in hand.

I had an experience of that kind once when I was promoted to a new job. I received no instructions other than the admonition: "This job will be whatever you make of it." This I interpreted literally, but soon realized, after several raps over the knuckles, that my interpretation was not in accord with that of the boss, and while my desire had been to please him I could have done so sooner if I had taken occasion to get more explicit instructions at the start. This is knowledge that cannot be obtained during a conversation, or be placed in a letter; it requires several contacts and sometimes is a long, difficult process, but is a necessity that should always be remembered. When these things are learned the most difficult part of the transition is past.

Make Changes Slowly

Having found out what is expected, the man on a new job should move slowly before making changes in the present order of things. He will, no doubt, find things that should be changed, but no changes should be made until all the facts have been weighed carefully. It will be well for him to remember that in all likelihood his predecessor was a man at least his equal in intelligence, and the organization as he finds it represents the result of much planning and work by that predecessor. In all probability, therefore, it does not need much if any revision. Even if a complete change to a different type of organization is to be made, it is surprising how many features of the old organization will fit into the new. When possible, changes should be made gradually, shading the new into the old to avoid too great and abrupt a change with the resulting confusion and expense. The man who disrupts an organization in his desire to make it appear that he is more aggressive or intelligent than his predecessor is making a mistake unless he can show definitely better results at less cost. Results, measured by cost, are the final answer to the merit of any method of doing work and, before making any changes, he should be certain that his method meets this requirement. New and better ways of doing things are being developed constantly and the opportunity for improving methods is always available to those who have their eyes open, but this should not be confused with the policy of making changes simply to give an appearance of activity.

When a man takes over a new job he begins what is a trying period, not only for himself but for those under him, as they are also unsettled until they get into the new routine and find out what is to be done. He should realize that his men have the same difficulty in finding out what he wants as he had in finding out what was expected of him. With this fact in mind he should give his subordinates a definite outline of what he expects of each one as soon as possible, carefully defining their work and their authority. The importance of doing this cannot be stressed too greatly.

In defining responsibility, great care should be taken to see that it is accompanied by authority. There is nothing more unfair than to make a man responsible for conditions that he does not have authority to control.

*Abstracted from an address presented before the Maintenance of Way Club of Chicago on January 20.

Having once delegated authority to a subordinate, that subordinate must be made to understand that he is responsible for the proper conduct of the matters entrusted to him and must make his own decisions and handle his own affairs without much help or advice from his superior. He must be made to feel that his superior officer has confidence in him and his ability to do the work entrusted to him, and that he will enjoy this confidence as long as his work warrants his being retained.

Most men enjoy authority. They realize that they are being put on their own mettle and resources, and they like to feel that the results that they are accomplishing are products of their intelligence and effort. This is a natural and commendable attitude and should be encouraged in every way. The department head who fails to do so will soon find himself at the head of a so-called "one man department" in which subordinates are afraid to move without being directed in every decision.

One of the worst handicaps that I have known men to work under is mental laziness, although often its presence is not realized. It is a habit that grows, and unless taken in hand and controlled early, it will stop any man's progress. The principal manifestation of this affliction is the inability to get things done at the proper time, the delaying of work for no good reason when a little energy and application would quickly solve what may appear to be mountainous problems. It is surprising how easily most things can be done when once attacked in the proper spirit.

Wanted—Good Men

I was once told by an officer of one of our large systems that the railroads are looking for men whom they can promote. Considering the number of men striving for promotion, this seemed like a foolish statement, but when we consider that he meant the roads wanted men who could be promoted with the assurance that they would handle their new jobs successfully without loss to the company and without causing their superior officers additional worry and trouble, we can come nearer to agreeing with him. It costs money for a man to fail, not only to himself but to his company as well. It is this loss to the company that the officer endeavors to avoid when selecting men for promotion. The subordinate desiring promotion must prove that he is an asset and not a liability to his company, and the only way that he can do so is by the manner in which he handles his work. To progress it is not only necessary for him to be capable and industrious in filling the job to which he may be assigned, but he must make his work so outstanding that it will attract the favorable attention of those on whom he must depend for promotion.

One of the best ways to attract attention is to develop a command of good English. No matter how intelligent a man is or how thorough his knowledge of the subject may be, his superiors cannot feel that he is well informed or thoroughly versed in the particulars of his work, unless he can convey to his listeners a clear and understandable picture of his subject through the medium of language. In other words he must be capable of using language that is so clear that his meaning is grasped instantly.

I believe that in order to be successful, a man must have such an open mind that he can learn from even the most lowly subordinate. The man in the ranks often has valuable ideas and knowledge, gained through long years of close association with his particular problems, and the man in charge who gains the confidence of his subordinates will have access to a fund of information that will often be most helpful to him. Also, his subordinates will appreciate his open-mindedness and will be more likely to give him full co-operation. In this connection it is my belief that when selecting a man for promotion, an officer will prefer one who has good judgment and a great capacity for work, although he may not be so familiar with the new job, to one who may have an intimate knowledge of the work but is known to be somewhat indifferent and lazy. Knowledge can always be gained by the man who is willing to work.

The individual who hopes to make a success of his work should broaden his knowledge of the workings of his railroad. There are many departments and one man cannot hope to understand all of them thoroughly, but the more he does understand the brighter and safer his future prospects will be and the more avenues will be open to him for promotion. For example, the technical engineer who makes it a point to study and understand maintenance doubles his usefulness and incidentally his opportunities for promotion.

A man should make every effort to be as helpful and useful to those around him as possible. He should make it a point not only to handle the immediate affairs of his work, but to let it be known that he is willing to help anywhere else when requested.

Make Decisions Promptly

Another good trait to develop is the ability to make decisions promptly. This does not mean that they should be made hastily or without proper knowledge, but just as soon as all facts have been assembled and studied the responsible person should make up his mind and render a decision. Decisions that are delayed too long after the facts have been studied are usually no better and often not as good as decisions rendered while the problems are fresh in mind. The man who must make decisions usually has other men under him that have to wait for his decisions and, as far as they are concerned, their work must wait until the decisions are made. Delays cost money and the man who can prevent delays is saving his company money.

Another simple rule that can be followed by any subordinate when he is with his superior officer is to make it a practice to stay as close as possible to his superior without being obtrusive. Being included in the party is an indication that his superior may want him at any time and he should be on hand when his presence is desired. A superior is not pleased when he has to send for a subordinate who should be at his side. It is natural for him to infer that the man who attempts to keep out of sight has something on his mind that he is trying to hide and the impression he makes is not good.

I have heard many ideas and opinions expressed concerning the things to do to be successful. That there is no definite standard for attaining success is apparent at once. If such a standard did exist it would have been printed in book form long ago, and in order to succeed all that would now be necessary would be to buy a copy and be governed accordingly. Of all the advice that I have heard, I do not believe that any was more valuable than the statement: "Handle your job so efficiently, so economically, and so entirely to the satisfaction of your superiors that when they have occasion to look around for a man to promote they will naturally be willing to bet their money on you to succeed wherever they put you."

After all fine theories have been expressed, they boil down to the fact that any job represents just so much work, and getting that work done efficiently and satisfactorily is the essence of success.

What's the Answer?

Have you a question you would like to have someone answer?

Can you answer any of the questions listed in the box?

Ballast First or Rail?

In raising the standard of track construction, involving the application of more and better ballast and heavier rail, if only the ballast or the rail is available, should the installation of the ballast precede or follow the laying of the rail ?

Ballast Should Follow Rail

By J. J. HESS

General Roadmaster, Great Northern, Seattle, Wash.

It is my opinion, formed through long experience, that the best practice is to lay the rail first. If the character and volume of traffic demand a higher standard of track construction, the application of the ballast certainly will not be delayed more than one season. It will rarely happen that the existing ballast cannot carry the new rail for at least one year without damage, provided the necessary tie renewals are made and the rail is properly surfaced and lined, a minimum raise of two inches being required.

This method will require no wasted effort, since the rail must be surfaced independently, no matter which sequence is followed. If the rail is laid first, the ultimate amount of ballast will be less. Furthermore, the life of the ties will be conserved. It would be poor practice to do the ballasting without renewing the ties, particularly as the question presupposes a less favorable tie condition than will be demanded by the new standard. If the ties are renewed in advance of the laying of the rail, they must be respiked when the rail is laid, thus shortening their life.

Would Prepare the Roadbed for the Rail

By E. L. BANION

Roadmaster, Atchinson, Topeka & Santa Fe, Independence, Kan.

If increased traffic demands a higher standard of track construction for a line that is laid with light rail and insufficiently ballasted, and if appropriations are available for only the rail or the ballast, I would most certainly choose the ballast. In this way I could put the roadbed and track in condition to handle the traffic safely and be assured that later the full potential service life of the rail will be obtained.

Low joints are invited when rail is laid in track that is insufficiently ballasted, while surface bending, inability to maintain line and battered rail ends are other accompaniments of this practice, which inevitably shorten the life of the rail and cause permanently poor riding track. It is false economy to lay rail under conditions which preclude its being given proper care.

Ballast Should Come First

By ARMSTRONG CHINN

Chief Engineer, Alton, Chicago

Usually, the necessity for raising the standard of track construction is brought about by increased tonnage, the use of heavier power or faster schedules, any one of which will mean greater stresses in the rail. If the full life of the heavier rail is to be realized, it must be protected at the time it is laid by having a good ballast support to preserve its line and surface. If the class of ballast in the track at the time the program is started is such that it will not give the necessary support to the

To Be Answered in July

1. Under what conditions is it sufficient to install subsurface drainage on only one side of a single track cut? Under what conditions are the advantages of a second line of drainage sufficient to justify its cost?

2. What precautions should be taken to minimize the probability of leaks in waterproofing on solid-floor ballast-deck bridges? If they occur, how can they be repaired? Is it necessary to take the track out of service?

3. What are the relative merits of the acetylene torch and the track chisel for cutting rails for yard use? Is the use of the torch permissible for cutting main-track rails?

4. When repainting wood surfaces, what special precautions are necessary that were not required for the first painting?

5. How should a surfacing gang of 35 men be organized for an average lift of 2 in. in gravel ballast, where the tie renewals are heavy and all ties must be spaced? How many lineal feet of track should such a gang complete in a day if it must "make ready" for six trains?

6. To what extent is it practicable and economical to bore treated bridge ties for track spikes prior to treatment?

7. Are surprise tests to detect unsafe practices and violation of instructions among maintenance men practicable and beneficial? If so, how and by whom should they be made?

8. What means can be employed to determine whether underground pipe lines are being subjected to electrolysis? If present, how can it be remedied?

new rail, and both rail and ballast cannot be furnished at the same time, then the choice should be for the ballast first, so that when the rail is received and laid, it will have a good foundation of ballast to preserve it. This procedure may require that a running surface be given the track after the rail is laid to correct any unevenness in line and surface, but this can be done at a small cost that will be more than offset by the increased life that will be realized from the rail.

Few things could be more harmful to new rail than to lay it in track that has insufficient or poor ballast and then let traffic run over it for a time before it is properly supported on good ballast. Under such conditions it will most likely be distorted so that it can never be restored to good line and surface. The ideal arrangement, of course, would be to lay the heavier rail first, and follow immediately behind with the application of the ballast.

Depends on Condition of Ballast

By L. A. RAPE
Section Foreman, Baltimore & Ohio, Smithton, Pa.

This is an important question which often comes up for decision, but each case must be decided on its merits, since the same combination of factors is seldom repeated. The decision will depend largely, however, on the condition of the rail and of the ballast, as well as on the time that will probably elapse before the second improvement can be made.

If new traffic conditions have arisen under which the old rail cannot be made safe, then by all means the application of the new rail should be given preference. Rail must be very light or in extremely bad condition, however, if it cannot be carried safely for one year on new ballast, even though it may not be entirely satisfactory from other view points.

Again, if the ballast is of such a character and in sufficient quantity to support the new rail without damage or excessive maintenance costs until the ballast improvement can be made, the application of the rail should be preferred, in order to derive the benefit from the heavier section. On the other hand, the quality and amount of ballast should be investigated carefully, since rail is easily surface bent and there is no remedy for the damage once it occurs. Battered joints can be corrected but the cost of doing so, added to other excess costs of maintenance, may more than offset the advantages of the heavier rail. For these reasons, good judgment often dictates that the ballasting be given preference.

[Space does not permit the publication of all of the 11 answers to this question, although they all contained interesting and valuable discussions of this important question. Among those who gave answers to the question, D. Hubbard, division engineer, Chesapeake & Ohio, advocated two qualifications of ballast, the first to be just sufficient to bring the old rail to good surface and the second to follow at the required interval after the rail is laid. W. R. Garrett, yard foreman, Chicago, Burlington & Quincy, called attention to the fact that if slot spiking is required by the standards of a road, the ties cannot be spaced until the rail is laid, thus making it uneconomical to apply the ballast in advance of the rail. This word of caution was also voiced by W. V. Waters, supervisor of track, Central of Georgia. W. H. Cleveland, general inspector of track, Atchison, Topeka & Santa Fe, particularly stressed the danger of damaging rail where the ballast condition is well below par. On the other hand, W. H. Sparks favors laying the rail first, since, as he said, ballast is rarely in such condition that the rail cannot be carried safely until the additional and better ballast can be obtained, while this method reduces materially the cost of spacing the ties after the rail is laid. John W. Riggans, track supervisor, Baltimore & Ohio, would clean the old ballast and raise the track to within two inches of the final elevation and then lay the new rail, following this with the ballast as soon as it can be obtained. In agreement with this view, R. Rossi, yard foreman, Alton, favors laying the rail in advance of the ballast application, to reduce the cost of tie spacing and to conserve the life of the ties by minimizing the amount of spiking which must be done on new ties.—Editor.]

Heartwood Up or Down?

Should treated ties be installed with the heartwood up or down? Why ?

If Down, Checking is Retarded

By W. H. CLEVELAND
General Inspector of Track, Atchison, Topeka & Santa Fe, Wellington, Kan.

All ties should be inserted with the heartwood down. If the heartwood is up, the annual rings open as a result of season checking and of the stresses imposed mechanically. In this position the cracks are concave or saucer shaped, and conduct moisture into the body of the tie. If the heartwood is down, the situation is reversed, the cracks are convex, and they shed the water. Sapwood has less resistance to decay than heartwood and will last longer if given a chance, when placed up, to dry out after rainfall. When embedded in the ballast it is kept moist and soft, in which condition it is particularly susceptible to decay. Furthermore, the sapwood is more easily damaged from tamping so that the corners of the tie are more quickly rounded, thus reducing the bearing area and the resistance to overturning.

Season Checking Is Less When Down

By W. H. SPARKS
General Inspector of Track, Chesapeake & Ohio, Russell, Ky.

Radial seasoning cracks always, or nearly always, start from the center of the log, or what was originally the center. The splitting which ultimately results, unless measures are taken to overcome it, is aggravated by direct exposure to the sun. For these reasons, a tie installed with the heartwood up generally splits along radial lines and becomes unfit for use long before it would have failed from other causes. As soon as the splitting has penetrated beyond the zone of treatment, the untreated wood is exposed and decay begins, and this may cause early failure, even if the splitting is not serious enough to do so. With the heartwood down, splitting seldom progresses to the point of failure because the heartwood is protected from quick drying by the ballast.

Ties Split Less Easily with Heartwood Down

By JOHN W. RIGGANS
Track Supervisor, Baltimore & Ohio, New Castle Junction, Pa.

All ties should be installed with the heartwood down, since experience has shown that they will give better and longer service when in this position. They do not split as easily when spikes are driven and they appear to have a greater resistance to the crushing action of the wheel loads. This resistance apparently arises from the fact that the annual rings form an arch which enables the tie to carry a greater load without damage than it can

when the heartwood is up and the position of the rings reversed. In any event, it is the common experience that when the heartwood is down, the tie will withstand greater abuse than when it is up. Furthermore, when the heartwood is down, the annual rings tend to shed water, while in the opposite position water finds a ready entrance through seasoning checks or cracks which result from crushing and splitting.

[Ten answers were received to this question, of which the three selected for publication were the most representive. W. V. Waters, supervisor of track, Central of Georgia, called attention to the fact that because the sapwood is softer than the heartwood it does not withstand the abrasion of tamping and contact with the ballast as well, and that the heartwood thus gives a better bearing on the ballast. Other answers, substantially agreeing with those published, were received from J. L. Brightwell, supervisor of track, Chesapeake & Ohio; L. A. Rape, section foreman, Baltimore & Ohio; H. Becker, section foreman, St. Louis-San Francisco; John Bednarz, section foreman, Great Northern; and W. R. Garrett, yard foreman, Chicago, Burlington & Quincy.

J. J. Hess, general roadmaster, Great Northern, is of the opinion that the life of both untreated and treated ties is extended by placing the heartwood up. He bases this opinion on his own experience and that of others who have had long contacts with users of wood in a great variety of applications.—Editor.]

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Paint on Wood Surfaces

Do some wood surfaces hold paint longer than others? If so, why? Is it desirable to mix the paint according to the kind of wood to be painted? If so, what factors should be given consideration ?

Paint Formulae Need not Differ

By General Inspector of Buildings

There is a wide variation in the density and character of woods and this is reflected in their ability to provide an anchorage for paint. As might be expected, the soft woods which are free from resins provide better anchorage for paint than those which contain large quantities of pitch. As an example, white pine holds paint well, except where highly resinous knots occur, and this wood is superior to most of the yellow pine surfaces.

Many painters labor under the impression that they must vary the mixture of the paint to correspond with the species of wood to be painted. In general, this is a fallacy, although up to a certain point it is true. The priming coat is always of greatest importance in the results which will be obtained on wood surfaces. It should always have a sufficient amount of oil to satisfy the absorbent demands of the wood to which it is applied, without impoverishing the oil content of the exposed film.

Some woods require the addition of a considerable quantity of thinner to insure the proper penetration of the wood by the paint. Others, such as yellow pine and similar woods having a high pitch content, may hold the paint better if the surface is washed with gasoline or benzine before the paint is applied. Too much oil or too heavy a priming coat is quite likely to result in cracking and peeling of the paint, however.

Spotting is quite likely to result from the application of a priming coat with insufficient oil to satisfy the absorbent power of the wood. Three light coats are generally better than two heavy applications. Only enough turpentine should be used on the surface coats to insure proper drying; otherwise the paint will crack and peel.

In general, the softwoods have the highest holding power for paint. The hardwoods which are low in resin content come next in the list, while those that are rich in pitch provide the poorest anchorage. The secret of securing good adhesion for the paint lies largely in obtaining a satisfactory penetration of the priming coat and this is accomplished by the addition of the proper amount of thinner, not by varying the paint formula. Some wood surfaces must also be washed with gasoline, benzine or benzol before satisfactory results can be assured.

There is a Marked Difference in Woods

By H. CUNIFF

General Painter Foreman, Delaware & Hudson, Green Island, N. Y.

Experiments made at the Forest Products Laboratory indicate that the cedars, cypress and redwood hold paint best. Northern white pine, western white pine and sugar pine do almost as well. Southern yellow pine and Douglas fir are abundantly available and their high strength makes them especially suited to building construction. However, with these and Western larch serious flaking of the coatings from the summer wood may occur sooner than from the other species mentioned. Western yellow pine, white fir, the hemlocks and the spruces fall between the white pine group and the southern yellow pine—Douglas fir group.

The retention of paint by a piece of lumber depends primarily upon the amount and distribution of summer wood in it. The dense, horny, dark colored portion of the annual growth ring formed in the tree during the late growing season is called summer wood. Its wood cells have thick walls and small cavities, hence it is less porous than the spring wood which has thin walls and correspondingly large cavities. Liquids move more readily through the summer wood and paint oils will penetrate deeper. Paint coatings do not seem to secure as firm an anchorage on summer wood, however, hence when paint coatings are exposed to normal conditions, they frequently flake from the summer wood while the film on the spring wood remains in good condition. Quite often it will be noticed that there is a greater difference in painting characteristics between spring and summer wood in a single board than between pieces of different species. All native soft woods contain both summer and spring wood, but proportions vary in different woods and in different boards of the same wood.

A painter need not change the composition of his priming coat mixture for different soft woods. On the contrary, he may as well adopt a single formula for mixing the priming coat. It is quite desirable, however, to exercise due precautions and proper care in the preparation of priming coats. For new soft pine or cedar siding the paint should be thinned to the proper spreading consistency with a mixture of two-thirds linseed oil and one-third turpentine. For priming spruce or fir siding the paint should be thinned with linseed oil and turpentine of equal proportions.

In priming hard pine the preparation of the priming coat depends upon the amount of resin or pitch which may be present. The priming coat should be rich in turpentine and the paint should be thinned to proper consistency with turpentine and linseed oil in the proportion of two-thirds and one-third, respectively. In other instances it may be necessary to wash the new lumber with gasoline or benzol and apply three thin coats, as two thick coats rich in oil will inevitably crack and

peel from such surfaces no matter how good the paint may be.

Cypress does not contain resin or pitch but always an excess quantity of oily sap which, when the wood is planed, feels like wax. This substance should be carefully wiped off with benzine when ready for staining. A good practice in priming hard pine and cypress doors is to add a cup full of benzol to each gallon of paint. In other instances where excess oil is not so noticeable, the same thinning procedure as with yellow pine has been used successfully. Douglas fir absorbs paint well but the paint dries rather slowly. The priming coat for this wood should be rich in linseed oil with just sufficient turpentine added to aid penetration. Unless red cedar is thoroughly seasoned, oil of cedar may remain. This acts as a solvent on paint coats and will destroy them. Red cedar is a poor absorber and plenty of time must be allowed for drying. The priming coat should contain plenty of oil and sufficient turpentine to aid penetration and should be brushed well into the wood.

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Failures of Bridge Ties

What forms of failure occur most commonly in treated ties on steel bridges? On timber trestles? What are the indications of approaching failure? What can be done to retard or eliminate such failures ?

Fail from Crushing

By F. O. DRAPER

Superintendent of Bridges, Illinois Central, Chicago

We have discontinued the use of creosoted ties on steel bridges. We use ties 8 in. by 10 in. and 8 in. by 12 in. The older types of tie plates, which did not cover the full width of the tie, sunk into the treated wood, causing the ties to bulge under the rail and the track became rough. We attributed the trouble to the softening of the wood by the treatment. Later, we adopted a method of dipping the ties and used full-width tie plates, since which we have had no further trouble.

Recently, we have started to build our open-deck trestles with all treated material, but we now install heavy tie plates on the ties on these bridges to protect them from crushing. We began using treated ties on trestles in 1904, without tie plates. The rail cut into these ties very quickly, so that renewals were excessive. The open-deck trestles we are now building have not been in service long enough to determine what the life of the ties will be, but as we are using heavy wide tie plates we are expecting to get 25 years of service from them.

Usually Fail from Outside Damage

By C. S. HERITAGE

Bridge Engineer, Kansas City Southern, Kansas City, Mo.

Most of the failures I have observed in treated ties on both steel bridges and timber trestles have been caused by rail cutting and excessive spiking, both of which expose the untreated center to decay infection. For the last 12 or 15 years we have been using creosoted ties, with tie plates, on steel bridges. Except for a few isolated causes of damage through derailments, all of these ties are in good condition. Earlier installations were made without tie plates and these gave only about 8 to 10 years' service, corresponding closely to that of untreated ties. Practically all of these failures were the result of mechanical damage.

Treated ties on bridge structures will not give full service unless protected from mechanical wear. Slot spiking should not be permitted, since any movement of the rail will tear or split the tie, opening a way for the entrance of water and decay—producing organisms.

Bridge ties that are not to be treated should be framed and bored in advance of treatment. If framing on the job is necessary, all cut surfaces should be protected with applications of hot creosote. If these precautions are taken, slot spiking is avoided and full sized tie plates are used, there should be few failures in treated ties on either steel or timber bridges.

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Double Stocking for Switch Points

What are the relative advantages and disadvantages of "double stocking" or housing the straight rail at turnouts for the protection of switch points during turnout movements ?

Recommends This in Yards

By JOHN W. RIGGANS

Track Supervisor, Baltimore & Ohio, New Castle Junction, Pa.

I recommend the practice of double stocking the straight rail at turnouts in yards or other points where the movement of traffic is slow. I do not recommend it, however, for high-speed tracks. The advantages of housing the point in this manner for turnout movements are that it increases the life of the switch point at least three-fold, while it decreases the likelihood that wheel flanges will catch the point in the event that the switch is sufficiently out of adjustment to allow the point to stand partly open.

Experience Has Demonstrated Economy

By W. P. HESTERLY

Section Foreman, Texas & New Orleans, Lufkin, Tex.

We protect our switch points by double stocking the straight rail and find that the practice demonstrates definite economies. We still have points in service that were installed with this form of protection about four years ago, in crossovers where the points formerly required renewal about every 12 or 15 months.

We are also using a type of switch-point protector which is attached to the rail. We find, however, that when they are applied on the lighter sections of rail, say 75-lb. and 80-lb rail, they tend to break the gage plates, owing to the strain which is imposed upon them when the flanges of the wheels come in contact with the protector.

Depends on Traffic Through Turnout

By W. R. GARRETT

Yard Foreman, Chicago, Burlington & Quincy, Pacific Junction, Ia.

An answer to this question must be made with several reservations. I would say that, in general, there is considerable advantage in double stocking the straight rail, since it will increase the life of the points far beyond any other form of protection. I would not recommend the practice for high speed tracks, however.

In evaluating the advantages of this form of protection, one must take into consideration the relative volume of traffic on the straight track as compared with that through the turnout. If the traffic through the turnout

is heavy and the points wear rapidly, this form of housing is very desirable. If, however, the volume of this traffic is so great that the turnout rails wear out as rapidly as the switch point, it offers no advantages, since the point must be changed with the rail.

Again, if the traffic on the straight track of such volume that the straight rail wears out as often as the point, even though the life of the latter may be short, there is no advantage in double stocking, since in this case also the point must be changed with the rail.

Is In Favor of the Practice

By G. STAFFORD

Section Foreman, Canadian National, Rosebud, Alta.

Obviously, there is advantage in housing the point in the side of the stock rail, and this practice has been in vogue on English railways since 1870. I do not see why it is not equally adapted for use with the straight rail. Objection has been raised on the ground that a lip or bead of flowing metal will be formed at the point of deflection of the housing. This has not been sustained, however, in the light of actual experience. By reason of its being fitted more snugly against the rail, the housed type of point receives more lateral and vertical support than the standard switch point. In addition, and in my opinion more important, the alinement of such a point conforms more nearly to that of a curved switch rail, a desirable condition in view of the long wheel base of modern locomotives.

Loose Bolts

What are the effects, if any, of loose bolts on track maintenance? On the riding qualities of the track ?

Tight Bolts Essential to Good-Riding Track

By J. L. BRIGHTWELL

Supervisor of Track, Chesapeake & Ohio

Tight bolts are essential to good-riding track, while they definitely decrease the cost of maintenance. Unless the bolts are tight, the joint fastenings cannot be made to fit properly, nor can the adjacent rails be kept in the correct relative alinement, either vertical or horizontal. Loose bolts mean loose angle bars and they in turn cause excessive vertical movement of the joint ties. This eventually depresses the surface and affects the line. The final result of this chain of events is that both the rail and the joint become worn and damaged and the riding qualities of the track are affected adversely, while the cost of maintenance mounts at a rapid rate.

Rail Becomes Badly Damaged

By D. HUBBARD

Division Engineer, Chesapeake & Ohio, Covington, Ky.

Loose bolts cause battered and mashed rail ends, surface-bent rails, worn fishing surfaces, surface-bent angle bars, cracked and broken angle bars, excessive wear on the joint ties, pumping joints and poor line and surface. In short, they affect adversely every detail of the joint assembly and, therefore, result in poor-riding track and abnormal maintenance costs.

Track cannot be kept in line and surface if the bolts are allowed to remain loose, regardless of the amount of time and effort that may be expended in an effort to accomplish this. Proper support at the rail ends is not possible so long as the bolts remain loose and in this condition the track cannot be made to ride smoothly. Bolts that are tight constitute a primary requisite in the maintenance of track.

Their Effect Is Very Great

By JOHN BEDNARZ

Section Foreman, Great Northern, Rugby, N. D.

While neglect of any feature of track maintenance may have far-reaching effects, there is so little excuse for loose bolts that it may well be said that they constitute one of the most serious defects in maintenance. They invariably result in battered rail ends and decreased life of the rail. The fishing surfaces of both the rail and the angle bars become worn, and in many cases the latter become surface bent and often break. When the rail expands from increasing temperature a lip may be formed at the joint, thus adding to the abnormal wear on the rail. All of these factors tend to shorten the life of the rail and all of them produce poor riding track.

Joints Are Weakest Link in Chain

By ROBERT WHITE

Section Foreman, Grand Trunk Western, Drayton Plains, Mich.

At present the rail joint is the weakest link in the chain which comprises the track structure. In my opinion it will continue to be unless changes are made in the design of the joint fastening, which will give it added strength and stiffness. Until these changes are made, however, joints will continue to absorb considerable of the time of the section forces or the quality of the track will depreciate rapidly.

Just how weak a joint may be will depend in large measure on the bolts. Bolts should be kept tight, but never overstressed. Track that contains loose bolts is almost certain to be afflicted with pumping joints. It will also contain battered rail ends, and because wear on the fishing surfaces is accelerated by loose bolts, the rate of batter is increased. As for noise, main tracks are seldom neglected to the point where this becomes noticeable, but side tracks often are until the joints jungle under traffic. Although the traffic on sidings is seldom as intensive as on main tracks, in my opinion it is fully as important to keep the bolts tight as on the higher-speed main tracks. Special attention should be given to insulated joints. If this is not done, the insulation may be damaged with consequent signal failures or crossing-bell failures, in which event trains may be delayed or some one suffer avoidable injuries.

Cannot Maintain Joints Properly

By HENRY BECKER

Section Foreman, St. Louis-San Francisco, Rush Tower, Mo.

Loose bolts are exceedingly harmful, since they increase maintenance costs, damage the rail and fastenings and cause poor riding track. Joints cannot be maintained unless the bolts are kept tight. If they are allowed to remain loose for any length of time they can never be kept tight, no matter how much attention they receive. This is due to the fact that the fishing surfaces have become worn. In many cases the angle bars also become surface bent. In either event, however, the fit between the angle bar and the rail is destroyed, and the lost motion thus created causes the bolts to loosen as soon as they are tightened.

If the bolts remain loose, rail batter begins to develop in a short time and progresses rapidly and at this stage

about the only remedy is to lay new rail. Loose bolts cause churning ties and poor alinement, both of which require maintenance far above normal. There is ordinarily little excuse for allowing bolts to remain loose and where this is done, it is a sure sign of neglect. It is almost certain that foremen who do not attend to this important detail of their work are also neglecting other matters of equal importance. In any event they are not only making work for themselves, most of which is not constructive, but they are allowing the rail, angle bars and ties, in fact the whole track structure, to be damaged beyond the possibility of repair.

[Answers to this question were also received from W. H. Sparks, general inspector of track, Chesapeake & Ohio; W. R. Garrett, yard foreman, Chicago, Burlington & Quincy; L. A. Rape, section foreman, Baltimore & Ohio; W. V. Waters, supervisor of track, Central of Georgia; Burt Hurst, section foreman, Missouri Pacific; and W. H. Cleveland, general inspector of track, Atchison, Topeka & Santa Fe.—Editor.]

Inclined Segmental Rollers

What methods, if any, other than jacking the bridge, can be employed to restore badly inclined segmental rollers under long heavy spans to proper position ?

Skew More Serious than Inclination

By R. W. JOHNSON

Assistant Engineer, Chicago, Milwaukee, St. Paul & Pacific, Chicago

On the road with which I am connected we usually resort to jacking for the purpose of straightening segmental rollers. There are other questions involved in the adjustment of segmental rollers, however. Rocker bearings which are without provision for spurs to engage slots in the upper and lower bearings usually rock back with the expansion, but as a result of dirt and rust which accumulate under the rockers they do not restore themselves from the inclined position. In a medium length span, say up to 250 ft., this is not a serious matter, for the span will slide back and forth with the rollers in this position. As a matter of fact, unless some means is provided for keeping the rocker nest interlocked with the top shoe and the bearing below, it is wasted effort to jack up the span and straighten the rollers, since they will only work back again and stay in the inclined position.

A skewed rocker rest is more serious than inclined rollers. The latter will tip only so far and remain in this position, while the skewing progresses until the rockers finally get above the guides on each side and in the center, making it difficult for the span to expand or contract properly. In some cases this condition will force the end rocker off of the bottom bearing. Where rockers are skewed, the customary method is to jack up the truss over the rocker rest needing adjustment. It is then blocked up, the nest is removed, cleaned, and adjusted, after which it is replaced.

Sometimes a skewed rocker nest can be adjusted by wedging the side that is farthest out of position against a backwall or the end bearing of an adjacent span in the early morning of a warm day. As the span expands it will carry the lagging side of the rocker rest along with it. By repeating the operation for two or three days, the skewed rocker rest can be straightened. This method may not be practicable where the skew is very pronounced or where the rollers are dirty and rusty.

If the stud bolts holding the side bars to the segmental rollers shear off, the quickest and most effective method of repair is to place two yokes around the rocker nest, one near the top and the other near the bottom, until the stud-bolt stubs can be drilled out and new bolts inserted. However, yokes made of two bars of steel and two bolts will last indefinitely. In the event, therefore, that the rocker nest sets in a recess where it is impracticable to drill out the broken stubs and insert new ones, the yokes can be left in as a permanent repair.

Must Shift Either Bed Plate or Span

By J. E. BERNHARDT

Bridge Engineer, Chicago & Eastern Illinois, Chicago

Segmental rollers are generally geared to bed plates and shoes. For this reason, it is necessary to shift either the bed plate or the span in order to straighten badly inclined rollers. If the bearing pedestals at the fixed end are two-piece pedestals and clearance can be provided or adjustments for increased clearance are practicable, the location of the fixed end can be changed to give the proper inclination to the rollers by sliding the upper pedestal on the lower casting. After this is done, the two parts can again be bolted or welded. Such procedure may not necessitate the removal of anchor bolts and provision for new anchorage.

Should it appear to be more feasible to move the bed plate to provide for the proper inclination of the rollers, the anchor bolts must be removed or cut off, the bed plate jacked to proper position and new anchorage provided. The shifting in either case is accomplished by the use of jacks shored or tied to the span.

A careful analysis should be made of the stresses created in the span by the jacking operation to insure against possible over stress. An effort should be made to cause the penetration of kerosene to as much of the area of the sliding contact planes as possible. The sliding operation can be greatly facilitated if part, at least, of the vertical load is removed from the bearing that is to be slid.

Recommends Lifting the Load

By P. G. LANG, JR.

Engineer of Bridges, Baltimore & Ohio, Baltimore, Md.

It is the common experience that segmental rollers inevitably tend to become inclined and cease to function as rollers. When this occurs the span must slide over the rollers. In addition to becoming inclined and sometimes locked in position, rollers have become skewed.

In designing a new structure, the ends should be made square, if possible, and the end floor beams should have sufficient strength to support at least the dead load of the span while it is being jacked. Furthermore, the segmental rollers should be provided with teeth meshing into slots in the upper and lower plates, so that, in effect, they will be geared, thus checking their tendency to become inclined. As an additional measure, the rollers should be grooved and guide strips placed to prevent them from skewing out of line. If the rollers are both skewed and inclined, it appears obvious that the sole method of restoring them to proper position is by jacking and realinement.

Theoretically, it would seem possible to take advantage of the span movement due to live load and by a simple arrangement of blocking cause the rollers to right themselves gradually under successive passages of the live

load, giving consideration to the longitudinal forces occasioned by the sliding friction, and other longitudinal forces. It is questionable, however, whether such a method can be used in actual practice. On this road whenever rollers need righting, the span is lifted by jacks or with a sling from a wrecking crane or other heavy derrick. In this connection it should be borne in mind that a lift of a fraction of an inch will answer the purpose and that for this reason one corner of a span can be lifted without disturbing the opposite corner.

Water Columns

What are the desirable characteristics of a water column? What undesirable characteristics are commonly found ?

Dependability, Durability and Positive Action

By R. C. BARDWELL
Superintendent Water Supply, Chesapeake & Ohio, Richmond, Va.

An excellent answer to this question appears on page 808 of the 1929 Edition of the Railway Engineering and Maintenance Cyclopedia, where it is stated that:

The desirable qualifications in a water column are a rapid delivery of water with a low frictional resistance to the flow of water, and a valve movement that may be handled and controlled easily without water hammer.

Other factors of importance are dependability, durability, positive action, ease of operation and low maintenance expense. Standardization, with its consequent reduction in repair stock, is a feature given consideration by many roads. Where water must be supplied to the new type of large engine tanks, which have capacities up to 23,000 gal., and where the same facilities must be used by the older power with tanks as small as 5,000 or 6,000 gal., the flexibility of the spout delivery becomes a matter of importance.

Undesirable characteristics which are found occasionally include restricted delivery, either at the spout (particularly with the old rigid type of spouts) or in the main valve and connections. In some instances, suitable provision is not made to take care of water hammer properly, which may cause damage on long delivery lines. Lack of satisfactory protection from corrosion and wear is undesirable, particularly near the packed connections.

Newer Designs Far More Satisfactory

By C. R. KNOWLES
Superintendent Water Service, Illinois Central, Chicago

The desirable characteristics in a water column are a rapid delivery of water with low frictional resistance to the flow of water, and a valve movement that may be handled and controlled easily without water hammer. The construction of the water column should be such as to permit it to be operated easily and to be economical in maintenance. The importance of the time element in train service requires that the delivery of water to the tender be made as quickly as possible. For this reason the waterway should be of ample size and the flow of water through the column as direct as possible.

Other essential features are non-corrosive moving parts, automatic drains and a locking or centering device that will hold the spout parallel to the track.

The water column should, of course, be equipped with an adjustable or telescopic spout with a wide vertical and horizontal range to permit delivery of water to locomotive tenders of varying heights without inconvenience or waste.

As a result of tests made at the University of Illinois in 1910, marked improvements were made in water columns, eliminating many of the undesirable characteristics, so that the newer designs are far more satisfactory than those on the market prior to that date. In selecting a water column, it is important to know that it will drain quickly and is able to withstand low temperatures without freezing, particularly if it is to be used on northern roads where severe winters may be expected.

Careful Maintenance Offsets Defects

By R. J. SOUTHCOTT
Foreman, Water Service, Canadian National, Toronto, Ont.

A water column should be easy to swing in either direction and to operate. It should be provided with a valve that opens wide enough to give a maximum discharge and closes surely but slowly to avoid water hammer. The spout should be long enough and have sufficient horizontal and vertical movement to serve all classes of engines without wasting water. The control valve should be equipped with a good key. The pits should be of ample size to permit inspection and repairs and both the pit and the column should have ample provision for quick drainage. In northern latitudes the pit should be protected with a frost floor.

Many undesirable features are found in some of the older designs, some of which have been corrected in later designs, among them lack of some of the desirable features mentioned. These undesirable features also include rapid wear of keys, slots, pins, couplings, counter-lever ends and holes, easily loosened piston-stem nuts and dome, and excessive wear on bushings. These defects all result in lost motion, prevent the valve from going to full opening and allow it to close before the cushion chamber can operate properly, so that water hammer often causes considerable damage to pipe lines. The machined end of these columns is not always smooth.

Among the defects which require considerable attention and decrease the amount of productive time of the water-service repairmen are the failure of the inclined castings in some types of columns to ride equally on the beveled rollers. When they are renewed they should be made in two sections to eliminate the necessity of lifting the entire column when making repairs. Cable wheels often stick, thus causing rapid wear on the cables so that they must be renewed with unnecessary frequency. In some columns the trolley-track nuts work up and allow the spout to drag on the tee. The lever guide and saddle should be so designed that they can be fastened securely, while a good operating lever and chain are required for satisfactory operation.

Another defect that sometimes occurs is that the valve chamber is not fastened securely and the piston valve and governor often require an undue amount of attention. In some cases the brass sleeves on the operating rods become pitted, tearing the bridge packing, thus allowing water to enter the rods. Corrosion will then affect their operation, often preventing the necessary movement, while in cold weather the water freezes, bursting the pipes.

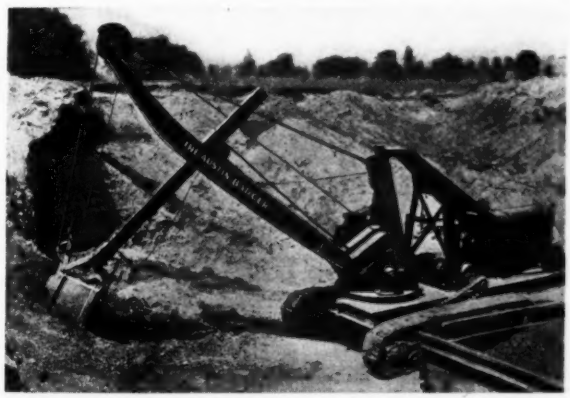
Those designs which have been simplified as much as possible and which have the maximum number of working parts visible and easy of access are to be preferred. In my experience, spouts welded with Tobin bronze give less trouble than the riveted type. While careful and persistent attention to maintenance will minimize the operating troubles which would otherwise result from these defects, the cost of doing so is often unduly high.

New and Improved Devices

Convertible Shovel and Crane Has New Features

A ⅜-CU. YD. convertible tractor shovel and crane embodying a number of unusual features for this type of equipment has been developed by the Austin Manufacturing Co., Chicago, the manufacturing division of the Austin Western Road Machinery Co. By the use of various attachments, this machine may be converted to use as a clamshell, a back-filler, a trench hoe, a dragline or a crane. When used as a crane, the unit is said to be capable of handling 33,000 lb. at a 15-ft. radius.

An outstanding feature of the machine, which is constructed without a cab, is the fact that the operator's seat, hoist drums, boom and mast are mounted together on a turntable which revolves independently of the frame and the power plant. A further advantage of this arrangement is that it permits the use of a greatly simplified crawler drive which is by means of a chain and



The New Austin Machine as a Shovel

sprocket directly from the engine. The mast is braced by a structural frame somewhat similar to that of a stiff-leg derrick, which has its legs welded to the floor of the tractor frame.

The shovel is equipped with a bucket of all-welded construction. The boom is formed from two 12-in. channels and is curved upward at its outer end to provide additional clearance for the dipper stick. With this arrangement the maximum dumping height is 17 ft. 10 in. with a boom angle of 55 deg.

Power is provided by the Model 20 McCormick-Deering industrial unit and speeds as high as four miles an hour are possible. The crawlers are 10 ft. 6 in. in length and measure 7 ft. 8 in. in overall width. Other mechanical features embodied in the shovel include the extensive use of heavy anti-friction bearings, booster-type clutches, brakes that are readily renewable, high-pressure lubrication at all points, and a high degree of accessibility.

Flexibility in road transportation is attained by the use of a set of rubber-tired wheels which permit the unit to be towed at a moderate rate of speed. By utilizing the power of the crawlers and with the aid of suitable blocks it is said to be possible to mount the shovel on its wheels in about 10 min. and to demount it in 15 min.

Dearborn Develops Concentration Hydrometer

WITH a view to affording an accurate determination of locomotive boiler-water concentration and thus giving officers in charge of water treatment a check on the use and performance of treated water, the Dearborn Chemical Company, Chicago, has recently developed and placed on the market a concentration hydrometer which is notable for compact design and the provision for all observations, temperature corrections and tabular references in a single instrument. Equipment previously employed for determining boiler-water concentration consisted of several units, the use of which required reference to charts and involved several operations which were not practicable to carry on while the locomotive was in motion.

The Hydrometer

The new Dearborn concentration hydrometer contains an in-built hydrometer, a thermometer and a conversion table, from which the grains of concentration per U. S. gallon are read. In assembling, the float with graduated stem is inserted in the glass tube and a rubber plug and bulb applied. The thermometer and scale are held in place beside the hydrometer.

In operation, boiler-water samples are taken from the water column or from the blow-off connection, in the former case the column being blown down at least twice before collecting the sample. To obtain a strictly representative sample the water should be drawn off through a condenser coil to prevent flashing. The water is permitted to cool to a temperature of 60 to 120 deg. F., then being drawn into the instrument and expelled two or three times to make sure that the glass temperature is the same as the temperature of the water. With the hydrometer floating freely, the float scale is read as soon as it comes to rest. A correction, corresponding to the temperature indicated on the scale of the thermometer, is subtracted from the float reading and the resultant figure referred to

the table built into the instrument which gives the corresponding concentration.

In testing samples containing from 600 to 1,100 grains per gallon, the temperature of the water should be 80 to 120 deg. F. in order to float the hydrometer within the limits of the float scale. The concentration range indicated by this hydrometer is from zero to 1,100 grains per U. S. gallon.

Medusa Floor Coating

A COATING for concrete and wood floors which is said to possess high abrasive and wear-resisting qualities has been developed by the Medusa Portland Cement Company, Cleveland, Ohio. This coating, which is manufactured in light gray, dark gray, brown, tile red and black, is applied in one coat to unpainted concrete floors over a thin film of Medusa floor primer, while two coats are applied to unpainted new wood floors and one to painted wood floors. When applied in one coat, a gallon of the floor coating is said to cover approximately 400 sq. ft. The advantageous features of the coating for concrete floors are attributed to a specially-prepared pigment and to its protection by Medusa floor primer from destructive agencies in the concrete.

Welding Outfit Comprises Two Independent Units

A PORTABLE track-welding outfit which consists of two independent power generating units, each of which is provided with a built-in cable reel, has been brought out by the Hobart Brothers Company, Troy, Ohio. With this arrangement two operators can work entirely independently of each other. Moreover, if desired, it is possible to remove one of the units for use elsewhere, thus making two single-operator welding outfits available.

Each unit is powered with a six-cylinder gasoline engine direct-connected to the generator and has a capacity of 300 amp. in continuous service. The units are provided with the Unitrol dial method of controlling the welding current and with Varispeed regulators which are said to make it possible to vary the speed of the engines so that 90 per cent of the welding may be done with the engines operating at reduced speed.

The engines are equipped with electric self-starters which are supplied with current from a standard six-volt storage battery, which is charged with surplus current from the exciter. It is thus possible to use the storage battery to operate any standard automotive type of headlight or spotlight when welding at night, without affecting the output of the welding generator. The ignition system consists of a standard automotive type distributor.

Each welding unit, including the cable reel which has a capacity of more than 700 ft. of cable, is housed in a steel canopy with removable side panels and with hinged doors at the reel end. The reels are mounted on ball bearings and each is equipped with a ring and brush arrangement to transmit the current to the cable without interfering with the operation of the reel. Wing-nut connections on the generator control panel also make it possible to use short lengths of cable for the welding nearby. A lifting bail is furnished on each unit. When both units are used, they are placed in reverse position on the car with respect to each other so that the cable reels may be unwound in opposite directions.

The car on which these units are mounted is of welded steel construction, with insulated wheels, and is provided with hand brakes and with adjustable set-off wheels of the eccentric-ratchet type. These wheels are located at the extreme corners of the car in order to simplify the placing of the set-off rails from the ends. Pin-type couplings are provided for towing the car.

The New Welding Outfit Illustrating the Reverse Position of the Two Units

With the aid of a special auxiliary generator these welding units may also be used to furnish current for the operation of track grinders and other electrically-operated equipment.

Hydraulic Jack for Clamping Ties

A PORTABLE hydraulic tie squeezer for compressing split or checked ties together while a device for holding them in this position is applied has recently been placed on the market by Greenlee Bros. & Co., Rockford, Ill. The main feature of this device is an hydraulic jack with a long plunger bar on which are mounted two heavy jaws that engage opposite sides of the tie. The jaw nearest to the jack is attached rigidly to the plunger while the outer jaw is bored to a diameter slightly larger than the plunger so the plunger is free to slide through it. The jaw is connected to the body of the jack by four flat bars. Therefore, when pressure is applied by means of a pump lever the tie is squeezed between the two jaws. This equipment exerts a maximum pressure of 25 tons.

Showing the Manner of Applying the Jack to a Split Tie

News of the Month . . .

Two Roads Recall Employees

Approximately 1,000 track employees have returned to work on the Chicago & North Western and 300 on the Alton to engage in spring maintenance work. This is the third group of employees to be re-employed on the North Western within the last three months.

Estimate Lower Car Loadings

Shippers of the country, through estimates submitted to the 13 shippers' regional advisory boards, anticipate that carload shipments of the 29 principal commodities in the second quarter of 1932 will be approximately 5,082,198 cars, a reduction of 756,374 cars, or 13 per cent, below the actual loadings for the same quarter in 1931.

Shippers Oppose Waste

The Northwest Shippers' Protective Association has been organized for the purpose of opposing the wasteful expenditure of public funds in attempts to bring about river navigation. The Shipstead-Mansfield bill, which proposes to appropriate $500,000,000 for river improvements, is opposed in particular. The organization is composed of shippers and receivers of freight operating in the Northwest.

Merchants Solicit Railroad Traffic

Faced with the possibility of curtailed railroad service, merchants of Herington, Kan., have banded together and are voluntarily soliciting traffic for the Chicago, Rock Island & Pacific, of which this town is a division point. By publishing the results of the campaign a spirit of rivalry is maintained. Since this move was instituted the railroad has enjoyed a substantial increase in traffic in this vicinity.

Express Agency Plans Truck Service

The Railway Express Agency, Inc., which is owned jointly by the railroads of the country, is planning to enter the highway trucking field on an extensive scale in the Chicago area, as a means of regaining for the railroads some of the l. c. l. traffic that has been lost to other highway agencies. The service contemplated would extend north to Milwaukee, Wis., and east to South Bend, Ind. As the first step in the plan an application has been filed with the Illinois Commerce Commission for authority to operate a freight transport service within the corporate limits of Chicago. Permission to establish the broader service must be obtained from the Interstate Commerce Commission.

Tank Car for Granular Commodities

A tank car, known as the Dry-Flo, which handles dry granular commodities in much the same manner as standard tank cars now handle liquids, has recently been perfected. The car is designed for the bulk movement of such dry materials as cement, lime, silica sand, sulphur, fertilizer, soda-ash, pottery clays, Fuller's earth, etc.

Two Months' Net Income Slumps

For the first two months of 1932 the Class I railroads of the United States had a net railway operating income of $33,739,170, which was at the annual rate of return of 1.08 per cent on their property investment, as compared with $62,054,969, or 1.98 per cent, for the corresponding period of 1931, according to reports compiled by the Bureau of Railway Economics.

Buses and Trucks Regulated in Kentucky

Motor bus and truck regulatory laws recently passed in Kentucky, place definite restrictions on the size and weight of these vehicles, require common carriers by highway to procure certificates of convenience and necessity and contract carriers to obtain permits, and levy mileage taxes according to the capacity of the bus or the weight of the truck. The operation of any vehicle exceeding 18,000 lb. in weight including the load is prohibited. Trucks are limited in length to 26½ ft., while trucks with semi-trailers may be 30 ft. long. The operation of trailers is prohibited, the trailer being defined as any vehicle drawn by a motor truck but supported wholly upon its own wheels.

I. C. C. Appropriation Reduced

An appropriation for the work of the Interstate Commerce Commission for the fiscal year 1933 of $7,228,179, which is $2,184,294 less than the appropriation for the current year, is provided for in the independent offices appropriation bill which was passed by the House of Representatives on April 9. The possibility that Congress might enact legislation repealing the recapture provisions of Section 15a of the Interstate Commerce Act, thereby reducing the work of the commission, will account for $1,483,321 of the total reduction.

New York to Chicago in 18 hr.

On April 24, the running time between New York and Chicago of the Broadway Limited and the Twentieth Century Limited, crack trains of the Pennsylvania and the New York Central, respectively, was reduced from 20 hr, to 18 hr., while most of the other New York-Chicago trains of these roads were placed on 21-hr. schedules. At the same time extra fares on all trains between New York and Chicago, except the Broadway Limited and the Twentieth Century Limited, were cancelled.

Broadcast from Moving Train

Radio broadcast from a moving train was successfully consumated on March 27, from a Baltimore & Ohio train running between Washington, D. C., and New York. It was stated that the quality of reception was almost equal to that of the usual broadcasting studio, only enough of the train sounds coming through to provide atmosphere. The program was sent from a studio set up in a dining car by short wave to pick-up stations, whence it was sent by wire to radio broadcast station WABC, and thence over a nation-wide network.

C. & N. W. Makes New Safety Record

The Chicago & North Western, which won the National Safety Council's award for railroads in Class A in the annual steam railroad accident prevention contest among employees in 1930, established a still better record in 1931, when the casualty rate, killed and injured per million man-hours worked, was 1.58, as compared with 2.59 in 1930. Employee fatalities were reduced 65 per cent and reportable injuries to employees 52 per cent. As compared with 1927, the record for 1931 represents a reduction of 91 per cent, the casualty rate in the former year having been 18.98.

Unregulated Trucks Injure Trade

That the indiscriminate operation of unregulated motor trucks presents a definite threat to business in general, as well as to the railroads in particular, was pointed out by General W. W. Atterbury, president of the Pennsylvania, in an address before the Economic Club of New York recently. For instance, the cement industry in Eastern Pennsylvania has been thrown into chaos by the introduction of unregulated truck competition, he said. As a consequence, no shipper knows his competitor's freight cost and hence finds it difficult to bid intelligently. Also, he continued, the fruit and vegetable markets of the great Eastern cities, which have been highly systematized with the aid of railroad cooperation, have been disrupted because of hap-hazard truck operation.

Association News

International Railway Maintenance Club

The next meeting of the International Railway Maintenance Club will be held on Monday, May 2, at the Royal York Hotel, Toronto, Ont. Following luncheon, which will be served at 12:30 p. m., a paper will be presented on hump yards and car retarders, by W. N. Skelton, supervisor of track, New York Central.

Maintenance of Way Club of Chicago

George H. Warfel, assistant to the general manager of the Union Pacific, was the speaker at a meeting held at the Auditorium Hotel on April 20, following a dinner which was attended by 40 members and guests. His subject was Accident Prevention Today. This was the last meeting for the season, the next meeting being scheduled for the latter part of October.

Roadmasters Association

Committees have now been organized to prepare reports on the two additional subjects reported in the April issue. C. H. R. Howe, cost engineer, C. & O., Richmond, Va., will direct the work of the Committee on Time Leaks in Maintenance Work, while T. A. Blair, division engineer, A. T. & S. F., Pueblo, Colo., will serve as chairman of the Committee on the Handling and Disposition of Used Materials.

Wood-Preservers' Association

June 21-22 have been selected as the dates for the summer meeting of the Executive and other committees of the Wood-Preservers' Association and of the Committee on Wood Preservation of the A.R.E.A. These committees will meet at Washington, D. C. After the completion of their work, they will be given an opportunity to inspect the research work which the Bureau ol Standards and other technical government agencies have in progress.

American Railway Engineering Association

The committees of the association are now actively engaged in work on their new assignments, two of them holding meetings during April. The special committee on Waterproofing held a meeting in Chicago on April 19 and 20, and the Committee on Maintenance of Way Work Equipment met at the same place on April 26. Four committees have already scheduled meetings for May—the Committee on Water Service and Sanitation at Memphis, Tenn., on May 3 and 4; the Committee on Iron and Steel Structures at Pittsburgh, Pa., on May 5 and 6; the Committee on Masonry at New York on May 12 and 13; and the Committee on Standardization at New York on May 20. A meeting of the Committee on Economics of Railway Labor is also being planned tentatively for May 5-6. The Board of Direction will hold its first meeting since the convention on May 17 at Chicago. Transcripts of the discussion at the convention in March have been sent out for review to all those who participated, preparatory to the assembly of the material for publication in the proceedings.

Metropolitan Track Supervisors' Club

The Metropolitan Track Supervisors' Club met at Keen's Chop House, New York, on April 21, with 35 in attendance, and, following dinner at 6:30, discussed a paper on maintenance of maintenance of way work equipment, presented by a committee of which Earl Mills, general gas engine inspector, New York Central, was chairman. Through the courtesy of the Boston & Maine, motion pictures were shown of recent fully machinized rail-laying operations on that road.

Rail Employees Drop Further

A further reduction in the number of railway employees from 1,108,691 as of the middle of January to 1,093,206 as of the middle of February is shown by figures released by the Interstate Commerce Commission. The February figure was 16.96 per cent below that for the same month last year, while the number of maintenance of way employees dropped 19.93 per cent.

Hopper Cars for Cement

The remodeling of 25 hopper cars into units suitable for carrying cement in bulk is being undertaken by the Pennsylvania at its steel car shops at Harrisburg, Pa. The completed cars will be covered and otherwise waterproof, with eight small hatches in the roofs for loading the cement. This move follows the conversion last December of six hopper cars for the same purpose as an experiment.

R. B. A. Reorganization

The Railway Business Association is being reorganized and expanded so that it may function more effectively for the good of the railways. The plans provide for changes in its administration and for refinancing on a larger scale so that the association can undertake an extensive campaign to better the present unsatisfactory situation of the railways. As a step in this reorganization, the headquarters of the association will be moved from Philadelphia to Chicago. Present plans also contemplate a change in the name, the Railway Manufacturers' Association having been suggested. Harry A. Wheeler, formerly vice-chairman of the First National Bank of Chicago, has been selected for president to succeed Alba B. Johnson and will lead the association in its broader activities.

Personal Mention

Engineering

E. F. Robinson, chief engineer of the Buffalo, Rochester & Pittsburgh, with headquarters at Rochester, N. Y., has been appointed assistant to the chief engineer of the Baltimore & Ohio, with the same headquarters, incident to the recent merging of the B. R. & P. into the Buffalo-Rochester district of the B. & O.

W. A. Spell, engineer maintenance of way of the Atlanta, Birmingham & Coast, has been promoted to chief engineer, with headquarters as before at Atlanta, Ga., to succeed **L. L. Beall,** whose death is noted elsewhere in these columns. The position of engineer maintenance of way has been abolished.

A. J. Gayfer, supervisory engineer in the construction department of the Canadian National, has been appointed division engineer of the Edson division of the Alberta district, with headquarters at Edson, Alta., to succeed **M. M. Churchill,** whose appointment as roadmaster is noted elsewhere in these columns.

E. E. Chapman, engineer of tests of the Atchison, Topeka & Santa Fe, with headquarters at Topeka, Kan., has had his jurisdiction extended over the chemical department and **O. T. Rees,** chief chemist, has been appointed to the newly-created position of assistant engineer of tests, with headquarters as before at Topeka. The position of chief chemist has been abolished.

L. B. Young, division engineer on the Schuylkill division of the Pennsylvania, with headquarters at Reading, Pa., has been transferred to the Williamsport division, with headquarters at Williamsport, Pa., succeeding **F. R. Rex.** Mr. Rex has been transferred to the Baltimore division, with headquarters at Baltimore, Md., to succeed **W. W. Portser,** who, in turn, has been transferred to the Schuylkill division, succeeding Mr. Young.

F. H. Cook, trainmaster on the International-Great Northern with headquarters at San Antonio, Tex., has been appointed division engineer at Palestine, Tex., with jurisdiction over the San Antonio and Palestine divisions. **W. Fields,** division engineer of the San Antonio division, at San Antonio, has been appointed office engineer in the chief engineer's office at Houston, Tex. and **S. Beacon,** division engineer of the Palestine division, at Palestine, has been appointed bridge and building supervisor, as noted elsewhere in these columns.

J. M. Harper, division engineer of that portion of the Vicksburg division of the Illinois Central which formerly comprised the New Orleans division, with headquarters at Vicksburg, Miss., has had his jurisdiction extended to include the re-

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mainder of the division except the Cleveland, Riverside, Leland, Silver Creek and Kimball Lake districts and the Glen Allen and Yerger branches, which have been transferred to the Memphis division. **C. J. Carney,** division engineer of that part of the Vicksburg division which formerly consisted of the Vicksburg Route division, with headquarters at Vicksburg, has been appointed supervisor of trains and track, as noted elsewhere in these columns under track.

W. H. Kirkbride, engineer maintenance of way and structures of the Southern Pacific, Pacific Lines, has been promoted to chief engineer, succeeding **George W. Boschke,** who died on March 3, as noted in the April issue. Mr. Kirkbride will have supervision over construction, maintenance and valuation matters. **W. M. Jaekle,** assistant engineer maintenance of way and structures, has been advanced to engineer maintenance of way and structures, to succeed Mr. Kirkbride. The headquarters of Mr. Kirkbride and Mr. Jaekle will be as before at San Francisco, Cal.

Mr. Kirkbride has been engaged in various capacities in railway location, construction, maintenance and operation for 34 years. He was born on January 22, 1874, at Pueblo, Colo., and graduated from Leland Stanford University in 1895. He began his engineering career in that year as a United States deputy mineral surveyor, but three years later took up railway work as an assistant engineer on the location

W. H. Kirkbride

and construction of the Sierra Railway of California. From February to August, 1902, Mr. Kirkbride served as chief of a field party on location of the Shasta Mineral Belt Railway and then entered the service of the Southern Pacific as an assistant engineer. Two years later he was promoted to roadmaster, then being advanced to assistant resident engineer in 1906, and to division engineer in 1909. In 1917, Mr. Kirkbride was transferred to the operating department as assistant superintendent of the Sacramento division. A year later, during federal control of the railroads, he was appointed chief engineer of the Southern Pacific, Pacific lines. In 1920, he was appointed engineer maintenance of way and structures, which position he held until his promotion to chief engineer, effective April 1. Since late last year, Mr. Kirkbride has also been chief engineer of the Northwestern Pacific, a subsidiary of the Southern Pacific.

Mr. Jaekle's railway career embraces 28 years of experience in engineering capacities on various railroads from New York to Mexico. He was born on January 9, 1883, at Brooklyn, N. Y., and received his engineering education

W. M. Jaekle

at Cooper Institute. He first entered railway service in 1904 as a trainman on the New York division of the Erie where he remained for a year, then going with the Missouri Pacific as an assistant engineer at St. Louis, Mo. Next, Mr. Jaekle went to Mexico where he served until 1907 as a transitman and chief of party on railroad location and construction with the National Railways of Mexico. In that year he joined the Southern Pacific as an assistant engineer at Sacramento, Cal., being promoted to assistant division engineer at the same point two years later. In 1910, Mr. Jaekle was sent to Portland, Ore., as a division engineer on the Oregon-Washington Railroad & Navigation Co., which, as a Harriman line, was at that time affiliated with the Southern Pacific. He returned to the latter company in 1913, as a division engineer at Bakersfield, Cal., being transferred to Los Angeles four years later. During federal control of the railroads, Mr. Jaekle held the position of engineer of maintenance for the lines south of Portland and west of Ogden, Utah, and El Paso, Tex. In 1920 he was appointed assistant engineer maintenance of way and structures of the Southern Pacific, Pacific System, which position he held until his recent promotion, effective April 1.

Floyd J. Pitcher, assistant engineer of structures of the New York, New Haven & Hartford, with headquarters at New Haven, Conn., has been promoted to engineer of structures, with the same headquarters, succeeding **P. B. Spencer,** whose death was noted in the April issue and of whom a biographical sketch appears elsewhere in this issue. Mr. Pitcher was born on February 6, 1888, at Somerville, Mass., and received his higher education at the Massachusetts Institute of Technology, from which he graduated in 1910. In October of that year he began railroad work on the Boston & Maine in the office of the engineer of structures, and in April, 1916, he left the railroad to become connected with E. W. Wiggin, consulting engineer at New Haven. In August, 1918, Mr. Pitcher entered the service of the New York, New Haven & Hartford in the engineering department, and in October, 1920, he was appointed assistant engineer of structures, the position he was holding at the time of his recent promotion.

James E. Lockhart, roadmaster on the Birmingham division of the Louisville & Nashville, with headquarters at Birmingham, Ala., has been promoted to the newly-created position of division engineer of the Knoxville & Atlanta division, with headquarters at Knoxville, Tenn. Mr. Lockhart was born on September 26, 1884, at Crofton, Ky., and graduated from Vanderbilt University, Nashville, Tenn., in June, 1907. Prior to becoming permanently connected with the Louisville & Nashville on February 1, 1909, he served on the engineering corps of a number of roads, including the Nashville, Chattanooga & St. Louis, and for a time was with the G. M. Best Construction Company. He served the L. & N. as an instrumentman in the maintenance and construction departments until April, 1912, when he was appointed an assistant engineer. Subsequently Mr. Lockhart was promoted to roadmaster on the Memphis line, after being transferred to the Atlanta division, with headquarters at Etowah, Tenn. Late in 1931, when the Atlanta and Knoxville divisions were consolidated, Mr. Lockhart was transferred to the Birmingham division, where he remained until his recent promotion to division engineer of the Knoxville & Atlanta division, with headquarters at Knoxville.

Track

C. J. Carney, division engineer of that portion of the Vicksburg division of the Illinois Central which formerly comprised the Vicksburg Route division prior to its consolidation with the New Orleans division, with headquarters at Vicksburg, Miss., has been appointed supervisor of trains and track on the Memphis division, with headquarters at Greenville, Miss.

S. C. Grizzle, general foreman of bridges and buildings of the Palestine division of the International-Great Northern, with headquarters at Palestine, Tex., has been appointed roadmaster, with headquarters at Mart, Tex., where he has jurisdiction over the territory formerly held by **J. S. Dryman,** roadmaster at Palestine, and **B. E. Glenn,** roadmaster at Mart, both of whom have been assigned to other duties. **J. D. Lowe,** roadmaster at Navasota, Tex., has moved

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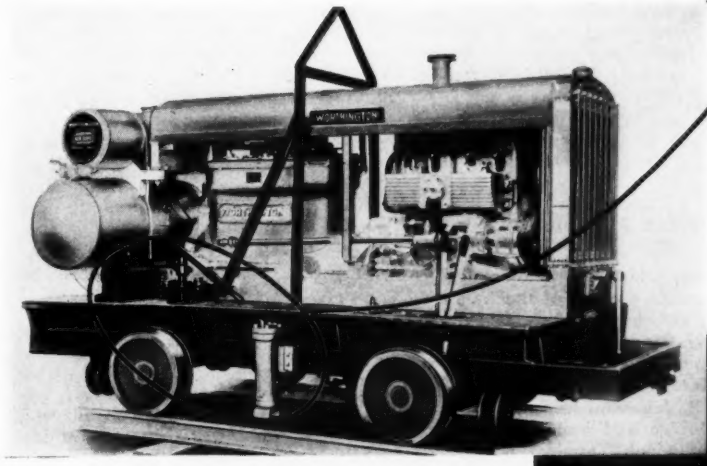

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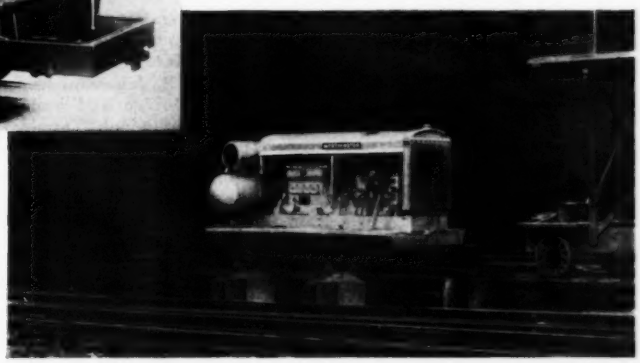

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WORTHINGTON

his headquarters to Houston, Tex. **A. C. Soechting,** roadmaster at San Antonio, has been transferred to Crystal City, Tex., where he succeeds **M. H. Smith,** who has been assigned to other duties.

M. M. Churchill, division engineer of the Edson division of the Alberta district of the Canadian National, with headquarters at Edson, Alta., has been appointed roadmaster of the Brule subdivision of the Edson division, with the same headquarters, succeeding **G. C. Barnett,** who has been transferred to Melville, Sask. Mr. Barnett succeeds **O. M. Valde,** who has been transferred to Watrous Sask. where he replaces **E. H. Brock,** deceased. **C. C. Johnson** has resumed his duties as roadmaster on the Canadian National, at Moncton, N. B., after having been off duty since last November because of an injury received when he fell from a motor car.

F. E. Schaumburg, whose appointment as roadmaster of the Fourth subdivision of the Eastern division of the Chicago & North Western was noted in the April issue, was born on May 30, 1899, at Jamestown, N. D. After a public school education he entered railway service on December 10, 1917, as a trainman on the Northern Pacific at Jamestown, where he served later as a rodman and an instrumentman. On August 6, 1924, Mr. Schaumburg left the Northern Pacific to accept a position as assistant division engineer on the Eastern division of the Chicago Great Western, with headquarters at Chicago. After five years with this road he entered the service of the Chicago & North Western as a construction accountant, which position he held until December 21, 1929, when he was advanced to assistant roadmaster on the First subdivision of the Galena division, with headquarters at Chicago. His further promotion to roadmaster on the Eastern division, with headquarters at Norfolk, Neb., took effect on March 1.

C. H. Staples, assistant roadmaster on the Second subdivision of the Galena division of the Chicago & North Western has been promoted to roadmaster of the Fourth subdivision of the Lake Shore division, with headquarters at Fond du Lac, Wis., where he succeeds **A. E. Benson,** who has been transferred to the Third subdivision of the same division with the same headquarters. Mr. Benson, succeeds **H. J. Anderson,** who has retired.

Mr. Staples has served in the engineering and maintenance of way departments of several railroads in addition to engaging for a time in the railway supply business. He was born on May 31, 1890, at Elmira, N. Y., and graduated from Elmira Academy in 1909. His first railway service, which began on June 1, 1909, was with the Delaware, Lackawanna & Western as a trainman. Shortly thereafter he was transferred to the engineering department as a rodman, subsequently being promoted to instrumentman. Later Mr. Staples accepted a similar position on the Erie, where he was promoted through the positions of chief of party, general foreman and supervisor of track. Next, Mr. Staples became connected with the O. F. Jordan Company in a sales capacity. After serving for a time with this company, he entered the service of the Chicago & North Western as a general foreman, later being appointed instrumentman. On July 1, 1929, Mr. Staples was promoted to assistant roadmaster, which position he held until his recent advancement to roadmaster, which was effective on April 1.

Bridge and Building

C. Carver, bridge and building master of the Portage division of the Canadian National, with headquarters at Portage La Prairie, Man., has been transferred to the Dauphin division, with headquarters at Dauphin, Man., where he succeeds **S. P. Jakeman,** who has been appointed bridge and building supervisor of the Winnipeg Terminal division, at Winnipeg, Man. Mr. Jakeman succeeds **J. MacBeath,** who has been assigned to other duties. The position of bridge and building master of the Portage division has been abolished.

S. Beacon, division engineer of the Palestine division of the International-Great Northern, has been appointed supervisor of bridges and buildings, with headquarters as before at Palestine, Tex,. with jurisdiction over the San Antonio and Palestine divisions. Mr. Beacon succeeds **S. C. Grizzle,** general foreman of bridges and buildings of the Palestine division, with headquarters at Palestine, who has been appointed roadmaster, as noted elsewhere in these columns, and **J. E. Rosenbalm,** general foreman of bridges and buildings of the San Antonio division, with headquarters at San Antonio, Tex., who has been assigned to other duties.

Obituary

C. H. Holmes, chief engineer of the Alaska Railroad, with headquarters at Anchorage, Alaska, died on April 9.

James T. Carpenter, retired supervisor of bridges and buildings on the Southern, died at his home at Princeton, Ind., on March 30, at the age of 87 years.

William R. Wires, roadmaster on the Chicago, Burlington, & Quincy, with headquarters at Aurora, Ill., died on April 8, in the Copley hospital at Aurora, as a result of injuries received in an accident. The position of roadmaster at Aurora has been abolished.

P. B. Spencer, engineer of structures of the New York, New Haven & Hartford, whose death on March 26 was noted in the April issue, was born on October 6, 1881, at Boston, Mass. He received his higher education at Worcester Polytechnic Institute, from which he graduated in 1902. Mr. Spencer entered railway work as a draftsman with the New York, Ontario & Western in 1902, serving later as an inspector and as assistant engineer. In 1905, he left the N. Y. O. & W. to become an assistant engineer on the New York, New Haven & Hartford, and in 1906 he again changed his connection to become resident engineer on the Charlotte Harbor & Northern. In 1907, he entered the employ of the Cambria Steel Company as an instrumentman and in 1908 left that company to return to the New Haven as an assistant engineer. Mr. Spencer later served as a resident engineer on construction, and on March 1, 1920, he was appointed assistant engineer of structures. On October 1 of that year he was promoted to engineer of structures, the position he was holding at the time of his death.

L. L. Beall, chief engineer of the Atlanta, Birmingham & Coast, died at his home at Atlanta, Ga. on March 22, following a heart attack. Mr. Beall, who was 66 years old, was a graduate of Lafayette College, Easton, Pa. Prior to becoming chief engineer of the A. B. & C., he was locating engineer for the Seaboard Air Line. During his career, Mr. Beall had also been connected with the Georgia Railroad, the Atlanta & West Point, the Charleston & Western Carolina, the Georgia Southern & Florida and the St. Louis-San Francisco.

Agnew T. Dice, president of the Reading, who early in his career served as an assistant engineer and supervisor of track on the Pennsylvania, died on March 25 at Philadelphia, Pa. Mr. Dice was born on November 2, 1862, at Scotland, Franklin county, Pa., and was educated at Chambersburg Academy. He entered railway service in 1881 with the Pennsylvania, as a flagman on the engineering corps, soon being advanced to rodman and then to assistant engineer. In 1887 he was assigned to special duties on signals, and a year later he was appointed assistant supervisor of track, being promoted to supervisor in 1890. In 1894, after two years of service with the New York Central, Mr. Dice entered the service of the Reading as superintendent of the Atlantic City Railroad, a subsidiary. He was advanced through various positions until his election as president in 1923, which position he was holding at the time of his death.

Trade Publication

Testing Machines.—Bulletin No. 28, containing 36 pages, which has recently been published by the Baldwin-Southwark Corporation, Philadelphia, Pa., is devoted to a discussion and description of this company's testing machines. The bulletin opens with a short history of the development of hydraulic testing machines, considerable space then being devoted to distinctive features of Southwark-Emery testing machines. The greatest portion of the booklet is used to describe specific machines manufactured by the Baldwin-Southwark Corporation.

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Lifting cranes, shovels, draglines, clamshells
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Build YOUR maintenance plan

around this many-purpose machine

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Supply Trade News

General

Fairmont Railway Motors, Inc., has moved its general sales offices at Chicago to 310 South Michigan avenue.

The Sullivan Machinery Company, Chicago, has moved its Knoxville (Tenn.) branch office from 623 Market street to Suite 803, Medical Arts building.

The Sellers Manufacturing Company, Chicago, moved its sales office from 231 South La Salle street to the company's plant at 4705 Montrose avenue on April 30.

The Dearborn Chemical Company, Chicago, has expanded its operations through the manufacture and sale of a new product known as Plumite, a chemical solvent for use in clearing clogged plumbing fixtures and soil pipe.

The Electric Tamper & Equipment Co., Chicago, has moved its sales headquarters from Chicago to Ludington, Mich., and will handle all inquiries, orders, sales and service correspondence from that location.

Lackawanna steel sheet piling, manufactured for many years by the **Bethlehem Steel Company,** will in the future be designated Bethlehem (Lackawanna) steel sheet piling and its sale will be handled by the **Kalman Steel Corporation,** a subsidiary of the Bethlehem Steel Corporation, although its manufacture will continue in the mills of the Bethlehem Steel Company. The **Pacific Coast Steel Corporation** will handle this product on the Pacific Coast.

Personal

Percival Chrystie, chairman of the board of the Taylor-Wharton Iron & Steel Company, High Bridge, N. J., died at that place on March 26.

Eben M. Byers, chairman of the board of the A. M. Byers Company, Pittsburgh, Pa., died on March 31 at the Doctors' Hospital, New York, at the age of 52 years.

J. J. Cozzens, representative of the Union Switch & Signal Company, with headquarters at New York, died at his home in East Orange, N. J., on April 22, at the age of 67.

H. H. Timken, chairman of the board of the **Timken Roller Bearing Company,** Canton, Ohio, was elected also president to succeed **M. T. Lothrop,** resigned, at a meeting of the board of directors at Canton on April 19.

Standard Equipments, Inc., 415 Lexington Avenue, New York, N. Y., manufacturer of Evertite rail joints, has opened an office in Room 2001, Straus Building, Chicago, in charge of **E. W. Backes,** who has been appointed western representative. After graduating from Pennsylvania Military College in 1920 and the Yale Graduate School in 1922, Mr. Backes spent four years and eight months in Havana, Cuba, with the Havana Electric Light & Power Company, as inspector, assistant engineer of ways and structures and engineer of ways, leaving Havana to enter the employ of the Boston & Maine at Boston, in May, 1927, where he served as general foreman, assistant engineer of construction, assistant division engineer and division engineer, leaving the railroad for his present position in March of this year.

Frank R. Wheeler has been appointed special sales representative, with headquarters at Chicago, of the **Worthington Pump & Machinery Corporation,** New York. He will cover the mid-west territory, assisting the Worthington organizations in Chicago, St. Paul, Kansas City, St. Louis and Detroit.

H. C. Darby has been appointed district sales manager for the **Inland Steel Company,** Chicago, with headquarters at the Kansas City (Mo.) office. Mr. Darby, who succeeds the late **Orville P. Blake,** has been a member of the sales force of that office since November, 1926. **Mark Hill** has been appointed a salesman in the Kansas City office.

William H. Croft, president of the **Magnus Company, Inc.,** with headquarters at Chicago, has been elected also vice-president of the **National Lead Company,** New York. Mr. Croft has been associated with the Magnus Company for 39 years, having entered the employ of the Hewitt Manufacturing Company, a subsidiary of the Magnus Metal Company, in 1893. In 1904 he became assistant to the president of the Magnus Metal Company and in 1905 was made sales manager. In 1907 the National Lead Company acquired the Magnus Metal Company and its subsidiary and Mr. Croft was elected vice-president in charge of operations and sales of both the Hewitt and the Magnus companies. When these two companies were merged into the Magnus Company, Inc., in 1915, Mr. Croft was elected first vice-president. In February, 1929, he was elected president, which position he will continue to hold with that of vice-president of the National Lead Company.

William H. Croft

R. L. Allardyce, general superintendent of plants of the International Creosoting & Construction Co., who died on February 27 at his home at Texarkana, Tex., as noted in *Railway Engineering and Maintenance* for April, devoted his entire business career to the wood-preservation field. Mr. Allardyce was one of the earliest advocates of exacting care in the preparation of timber for treatment and was the originator of the Allardyce process of timber preservation. He was born at Galveston, Tex., 67 years ago, and entered the service of the International Creosoting & Construction Co. in 1892. Subsequently, he was promoted to treating engineer and then to superintendent of the Beaumont (Tex.) plant. In 1904, Mr. Allardyce received the further promotion to general superintendent of plants, which position he held until his death.

R. L. Allardyce

Myron C. Taylor, chairman of the finance committee and a director of the **United States Steel Corporation,** was elected chairman of the board of directors at its monthly meeting at New York on March 29. Mr. Taylor succeeds **J. P. Morgan,** who had asked the board to agree to his retirement from the chairmanship which he had assumed at the request of the board as an interim measure following the death of the late Judge Gary. Since Mr. Taylor's election as chairman of the finance committee in 1927, he has been active in carrying out a reorganization program which contemplates the retirement of the bonds of the corporation and its subsidiaries, the modernization of plant facilities, the building of additional plants and the acquisition of desirable property. Mr. Taylor was born on January 18, 1874, at Lyons, N. Y., and graduated from Cornell University in 1894. He was educated in law, but his chief interests have been in business. He was associated with the textile industry in New England and for many years was a prominent figure in various large enterprises. Mr. Taylor holds various positions on the directorates of a number of corporations.

WOODINGS-VERONA TOOL WORKS

ANNOUNCES

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A SPRING DEVICE, FOR TRACK BOLTS, OF LONG COMPRESSIVE CAPACITY RANGE AND OF UNUSUALLY HIGH REACTIONS.

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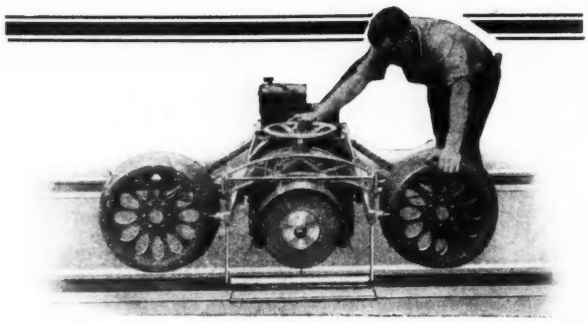

Railway Track-work Company Portable Track Grinder, Model P-3

Grinding wheel operates on either rail. Single throw hand lever operates a jack enabling operator to swing machine for grinding opposite rail. Grinds gauge line or outside of rail at 9500 surface ft. per min. Electric motor driven. Quickly adjusted roller permits speedy derailing. Model P-6, same as above except that it is operated by a gasoline engine.

Shop economy in track maintenance

THE economy of special machines available in your shops, now is at your service also for removing surplus metal after building up rail joints by arc welding.

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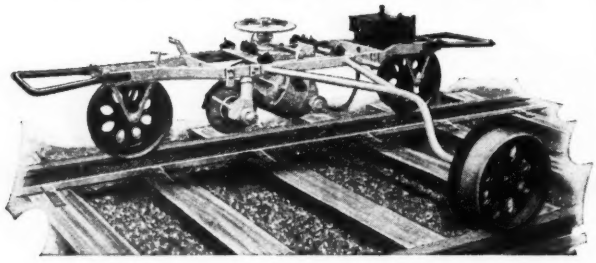

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Two wheels on one rail. Outrigger on opposite rail, quickly removable, permits parking grinder on neutral ground to pass train. Electric motor operates grinding wheel at 9000 surface ft. per min. Adjustable laterally and vertically. May be reciprocated 16-in. Flexible shaft carries grinding wheel for beveling joints.

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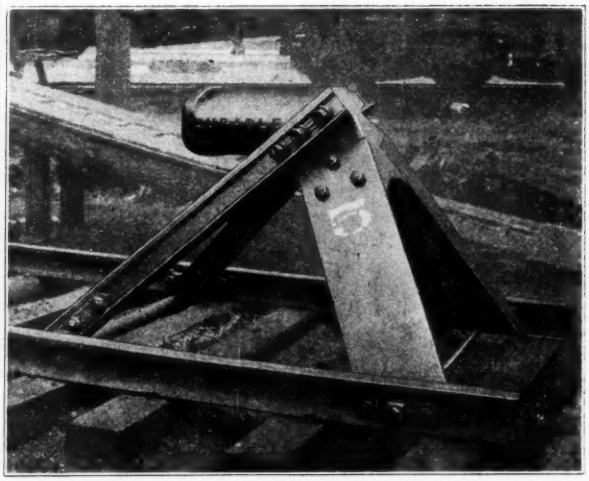

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ZECO GREENSAND ZEOLITE

STATEMENT of the ownership, management, circulation, etc., required by the Act of Congress of August 24, 1912, of RAILWAY ENGINEERING AND MAINTENANCE, published monthly at Milwaukee, Wis., for April 1932.

State of Illinois } ss.
County of Cook }

Before me, a Notary Public in and for the State and county aforesaid, personally appeared Elmer T. Howson, who, having been duly sworn according to law, deposes and says that he is the editor of the RAILWAY ENGINEERING AND MAINTENANCE, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411, Postal Laws and Regulations, printed on the reverse of this form, to-wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers are:
Publisher, Simmons-Boardman Publishing Company, 30 Church St., New York, N. Y.
Editor, Elmer T. Howson, 105 West Adams St., Chicago, Ill.
Managing Editor, Walter S. Lacher, 105 West Adams St., Chicago, Ill.
Business Manager, F. C. Koch, 30 Church St., New York, N. Y.

2. That the owners are:
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3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

ELMER T. HOWSON.

Sworn to and subscribed before me this 31st day of March, 1932.

ANNE A. BOYD.

[Seal] (My commission expires Dec. 8, 1935.)

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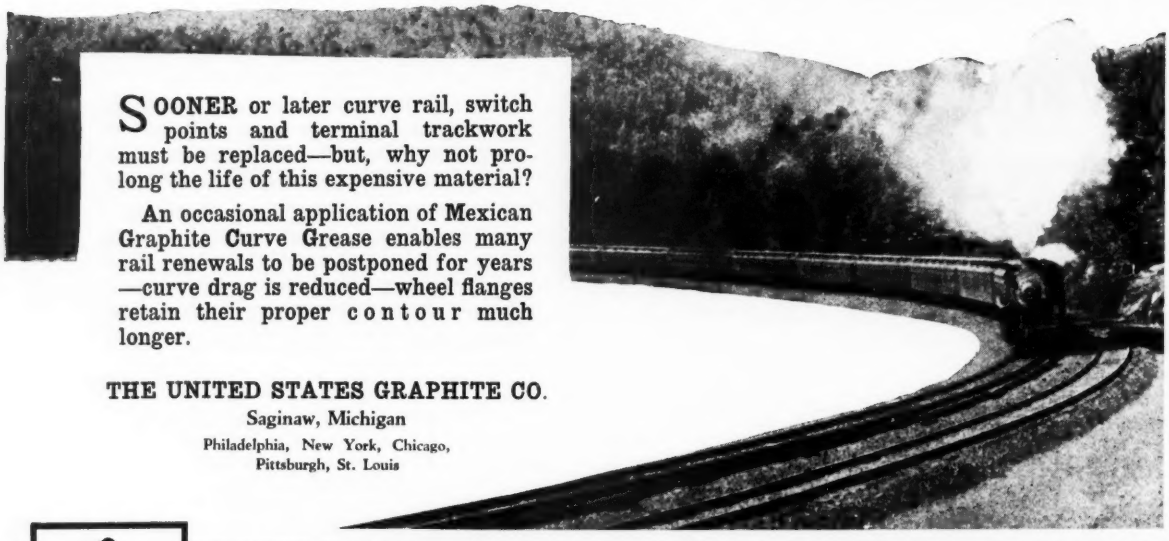

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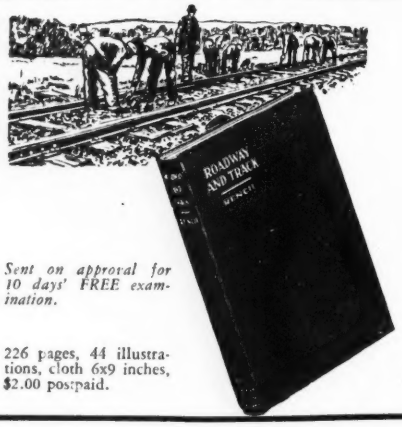

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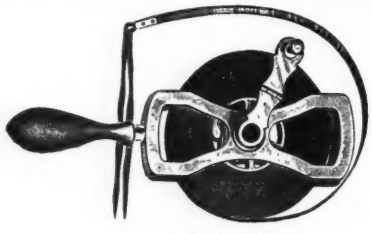

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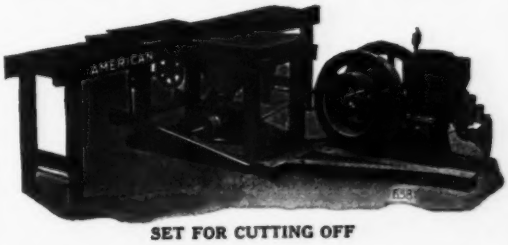

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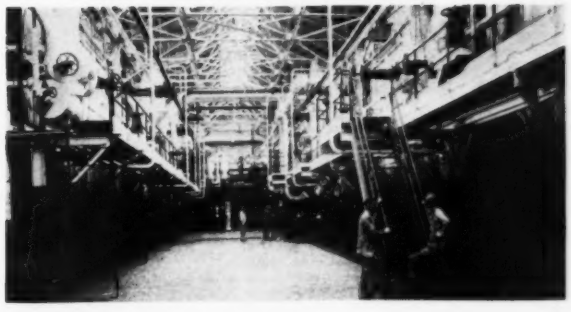

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SPENO Ballast Cleaning Service gives you the finest job of ballast cleaning at low cost. No capital investment is required. Just contract on a lineal foot, mileage, time, or on any other basis. Speno Service includes the efficient Speno Ballast cleaner, a foreman, an operator and a laborer, each well trained in this class of work.

The Speno Cleaner does a thorough job. The scoops pick up for cleaning a straight swath of ballast with a perfectly uniform bottom. No ballast is missed. Even the fringe of ballast along the tie ends is cleaned.

Last summer this machine cleaned 200 miles of intertrack ballast, working one shift a day for 135 days, and operating only one of its sides at a time, and clearing for traffic.

For complete information and prices write to

FRANK SPENO RAILROAD BALLAST CLEANING CO., INC.
628 West State Street ITHACA, N. Y.

MODEL-OB CLAMSHELL
WITH 6'-6" SWING RADIUS CENTER PIN TO REAR END

7/16 Yd. Buckeye CONVERTIBLE SHOVEL CLAMSHELL CRANE DRAGLINE BACKFILLER

SEVEN-SIXTEENTH YARD CAPACITY

Full revolving-convertible to seven-sixteenth yard SHOVEL, CRANE DRAGLINE or BACKFILLER. Every part designed and built for constant, full-capacity, long time service. The BUCKEYE Patented SPRING STOP SHOCK ABSORBER entirely eliminates swing clutch slippage and shock to relative parts at the moment of reversing. REAL 1932 CAPACITY VALUE with BUCKEYE DEPENDABILITY for power, speed, economy and performance. Flanged wheels or Alligator crawlers. WRITE TODAY for the MODEL OB specifications and descriptive bulletin.

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Findlay, Ohio, U. S. A.

Railway sales representative—THE HOPKINS COMPANY, Marquette Bldg., Chicago, or 241 Euclid Ave., Cleveland

for over thirty years **Buckeye**

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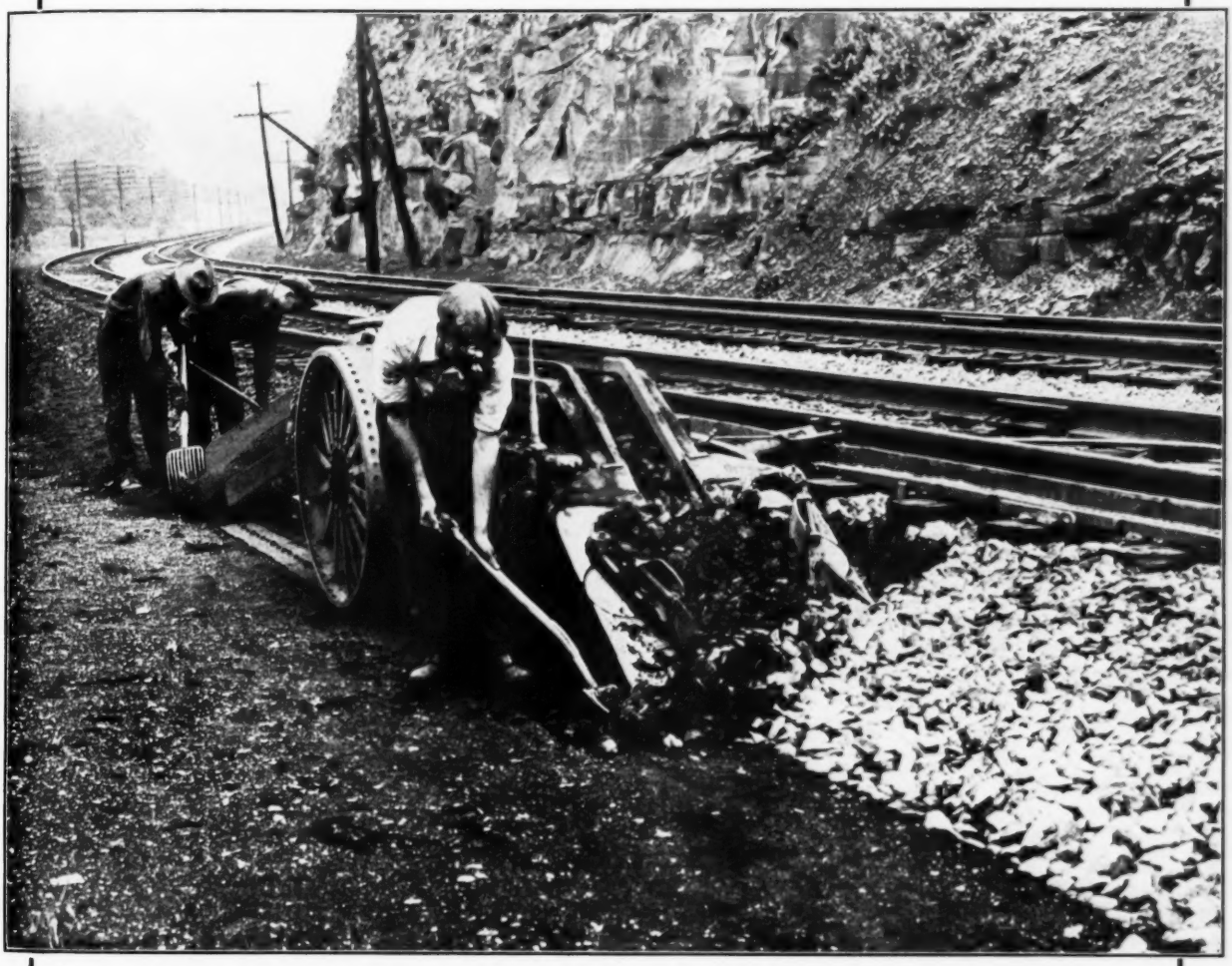
MOLES

Clean Ballast Without Obstructing Tracks



When traffic is normal, occupancy of tracks by maintenance equipment is a serious operating problem, and a source of increased operating expense due to delay of revenue trains.

Necessary clearing by work equipment causes loss of time and a corresponding increase in unit cost of work being performed. Railroads should plan their maintenance equipment so as to secure the maximum performance at the lowest cost under normal conditions. Equipment occupying tracks, which may be economical under present conditions, may be too expensive to consider under normal traffic density.

Moles will clean ballast, both between the tracks and on the shoulder, better and cheaper than any other method, whether traffic is light or heavy.

RAILWAY MAINTENANCE CORPORATION

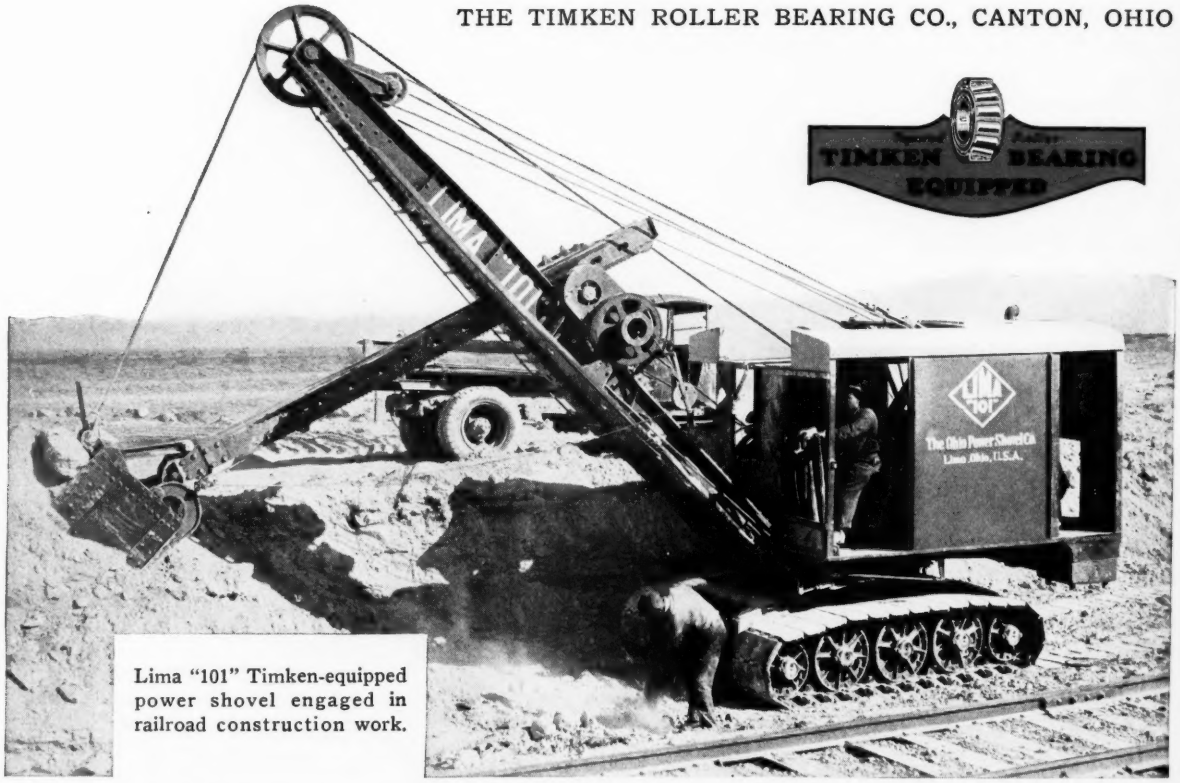
Pittsburgh, Pa.

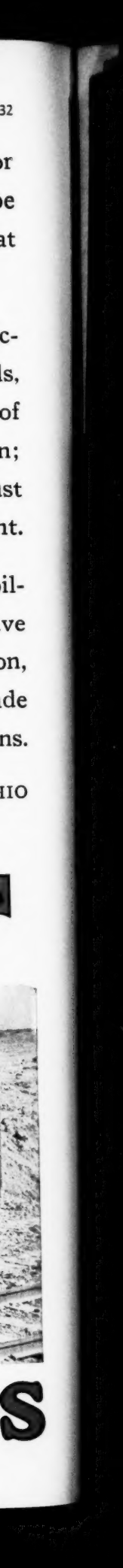
NO matter what type of maintenance or construction equipment you may be buying, it will pay you to see that it is Timken Bearing Equipped.

Leading manufacturers of inspection cars, section motor cars, trailers, push cars, power shovels, pumps, compressors and special equipment of various types use Timkens to overcome friction; save power and lubricant; carry radial-thrust loads; and hold shafts and gears in alignment.

You can have no better assurance of dependability and long life than the presence of the exclusive combination of Timken tapered construction, Timken positively aligned rolls and Timken-made steel at the heavy duty points. Specify Timkens.

THE TIMKEN ROLLER BEARING CO., CANTON, OHIO



Lima "101" Timken-equipped power shovel engaged in railroad construction work.

TIMKEN *Tapered Roller* BEARINGS